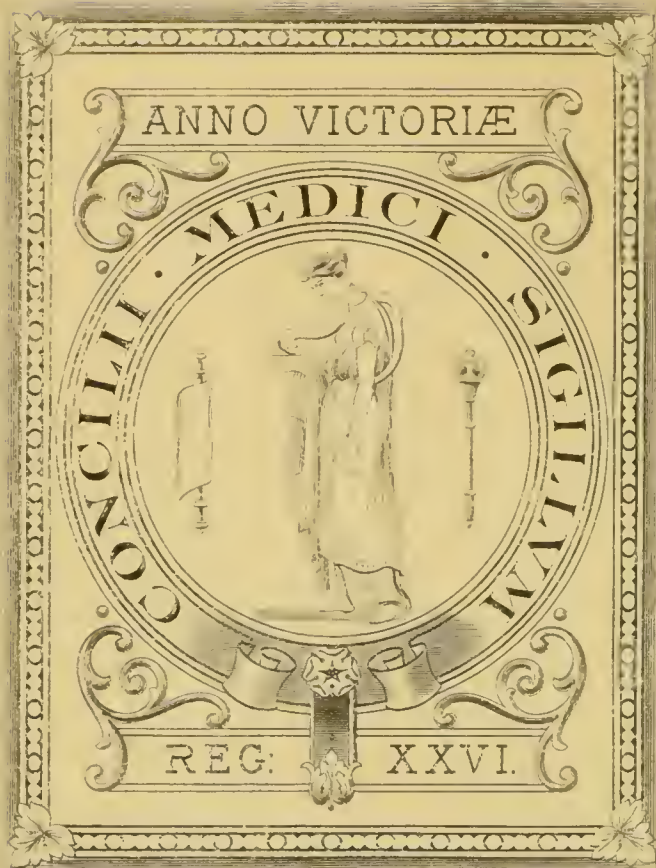





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THE
WORKS,
LITERARY, MORAL,
AND
MEDICAL,
OF
THOMAS PERCIVAL, M.D.

F. R. S. AND A. S.—F. R. S. AND R. M. S. EDIN.

LATE PRES. OF THE LIT. AND PHIL. SOC. AT MANCHESTER; MEMBER OF
THE ROYAL SOCIETIES OF PARIS AND OF LYONS, OF THE MEDICAL
SOCIETIES OF LONDON, AND OF AIX EN PROvence, OF THE
AMERIC. ACAD. OF ARTS, &c. AND OF THE AMERIC.
PHIL. SOC. AT PHILADELPHIA.

TO WHICH ARE PREFIXED,
MEMOIRS of his LIFE and WRITINGS,
AND A SELECTION FROM HIS
LITERARY CORRESPONDENCE.

A NEW EDITION.

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T O

SIR GEORGE BAKER, BART.

PHYSICIAN IN ORDINARY TO THEIR

MAJESTIES;

PRESIDENT OF THE COLLEGE OF PHYSICIANS;

FELLOW OF THE ROYAL SOCIETY;

OF THE

SOCIETY OF ANTIQUARIANS IN LONDON;

AND OF THE

ROYAL SOCIETY OF MEDICINE AT PARIS;

&c. &c.

T H E S E E S S A Y S

ARE INSCRIBED,

AS A RESPECTFUL TRIBUTE

TO PRE-EMINENT

LITERARY AND PROFESSIONAL MERIT;

A N D

AS A GRATEFUL MEMORIAL

OF ESTEEM AND FRIENDSHIP,

B Y

T H E A U T H O R.



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THE present Edition of this Work comprehends not only the author's former volumes, of Medical, Philosophical, and Experimental Essays; but also many detached pieces, written at distant times, and on various occasions, that have been inserted either in the Transactions of some of the learned Societies, of which he is a member, or in other Periodical Journals. He has attentively revised the whole; has made numerous practical additions; and corrected or expunged whatever appeared to be inconsistent with his later experience, and better informed judgment. On certain philosophical subjects, of which he has treated, much light has been thrown by subsequent inquirers. He has not, however, attempted to remodel such Essays anew; or to weave into their texture discoveries and improvements, made since the period when they were written. For he deems anachronism, of this kind, to be a violation of literary property; and unfavourable to the interests of science, by creating perplexity in the view of its progressive advancement.

MANCHESTER, FEBRUARY 11, 1788.

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E S S A Y S

MEDICAL, PHILOSOPHICAL,

A N D

EXPERIMENTAL.

P A R T I.

*Quantacunque fuerint aliorum conamina, semper
existimavi mihi vitalis auræ usum frustra datum fore,
nisi et ipse, in hoc studio versatus, symbolum aliquod,
utcunque exiguum, in commune medicinæ ærarium
contribuerem.*

SYDENHAM.

T H E

P R E F A C E.

THE Author of the following
Essays, presuming on the can-
dour with which they have
been received, commits to the same
indulgence, the present enlarged and im-
proved edition of them. The first and
second Dissertations are the productions
of his youth, and illustrate both the in-
sufficiency of THEORY, and the danger
of trusting to EXPERIENCE alone in the
practice of physic. The annals of medi-
cine abound with instances of the fatal
effects of empiricism, and hypothetical
reasoning, founded on fictitious principles.
But these examples, painful as they are
to a feeling mind, impeach not the honour
or

or usefulness of the healing art; and are chargeable only on the ignorance of a few of its professors, and on the credulity of mankind. The History of the Christian Church presents us with a picture still more shocking to humanity: But who disputes the influence of religion, to promote the peace, order, and happiness of society, because superstition hath occasioned so much confusion, misery, and devastation? It is seriously to be lamented that juster ideas are not formed of the nature, extent, and objects of medicine in general; and of the several branches, into which, as a practical science too comprehensive for any individual to profess, it is now divided. This would prevent the encouragement of illiterate pretenders; would conciliate harmony, and excite a generous emulation amongst the different orders of the faculty; and by confining the exertions of each, within the sphere adapted to their genius and education, would powerfully promote the improvement of Physic, Surgery, and Pharmacy. No profession requires a more
enlarged

enlarged and cultivated understanding, or comprehends a wider circle of knowledge than that of physic. And to the honour of the physicians of this age and country, it may with truth be asserted, that they are peculiarly distinguished as men of liberal education, and extensive learning.

THE third Essay consists of Experiments and Observations on BITTERS and ASTRINGENTS in general, and on the PERUVIAN BARK in particular (*a*). The
utility

(*a*) Of this Essay, which was first published in 1767, large portions have been copied into several Cyclopædias, and Treatises on the Materia Medica, both foreign and domestic. The author has reason to believe that the practical and pharmaceutical doctrines it contains have been generally adopted. Two very ingenious writers, however, have lately controverted the results of some of the experiments which he has related. He acknowledges with satisfaction the candour of these Gentlemen; and thinks himself honoured by their approbation of his works. But the points in dispute, he must leave to the decision of others; having *now* no leisure for such investigations. He is sensible that, in the course of his inquiries, he must have been liable to many sources of fallacy: But the same observation, he presumes, is not more applicable to him than to others engaged in experimental researches. And he trusts the reader will perceive,

utility of this method of inquiry is universally acknowledged ; and nothing can tend more to the advancement of real science, than the steady pursuit of it. The improvements made in the art of medicine for this century past, are more than equal to those of a thousand preceding years. And these improvements may be justly ascribed to that taste for experiment, which hath of late so generally prevailed. But though much hath been done in this way of investigation, there are still numberless untrodden paths in physic which remain to be explored. And every person of tolerable abilities, who has patience, assiduity, and a sufficient minuteness of attention, may almost assure himself that

perceive, in the following pages, that he has endeavoured with cautious solicitude, to guard against the undue influence of preconceptions ; that he has faithfully related facts and appearances as they occurred, whether favourable or unfavourable to his opinions ; that his experiments are numerous, diversified, and frequently repeated in the pursuit of different truths ; and that they were made at a period when the Peruvian bark was easily obtained unadulterated, and of a good quality.

MARCH 7, 1788.

his.

his labours will be rewarded with success, and that he cannot fail of adding some new and useful discoveries to the common stock of medical knowledge. *Multum egerunt qui ante nos fuerunt, sed non peregerunt; multum adhuc restat operæ, multumq; restabit, neque ulli nato post mille secula præcidetur occasio aliquid adhuc adjiciendi (b).* The author might have confirmed many of the observations contained in this Essay by a variety of experiments, which he has lately made on the Columbo Root; a medicine, which from its efficacy, deserves to be more generally known in practice. But his papers on that subject are laid before the Royal Society, and will probably be published in the next volume of Philosophical Transactions.

THE title of the fourth Essay fully explains the purport of it. An attempt to ascertain the use and operation of a remedy so well known as BLISTERS, may at first view appear to be unnecessary. But a more attentive examination will

(b) Seneca.

convince us of our mistake. The triteness of the subject is the reason that it has been so much overlooked and neglected; and though vesicatories are employed and recommended by almost every medical practitioner, yet few have attended to their real action, or to the general principles which ought to direct their application.

THE subject of the fifth Essay, the author confesses, is rather curious than useful; of more importance to the inquisitive physiologist, than to the practical physician. But as all researches into the operations of nature merit our notice and regard, an inquiry into the resemblance between the CHYLE and MILK hath certainly some claim to attention. And if it appear probable, as he presumes it will, that milk is the chyle unaffimilated, or at least very little changed, it may lead to some useful inferences concerning the proper diet for nurses.

THE tracts on WATER, and on early INOCULATION, were published, separately, a few

a few years ago ; and as no copies of the former impressions now remain, they are reprinted and annexed to this volume of Essays.

THE Observations on the efficacy of External Applications in the ULCEROUS SORE THROAT were written in the summer of 1770, a period when that disease was epidemical in the town and neighbourhood of Manchester. The Measles also prevailed very generally at the same time ; but though these disorders have been often observed to associate together, and may seem to bear some analogy to each other, from the efflorescence on the skin, and inflammation of the eyes, with which they are both accompanied, no instance then occurred to the author of their union.

MANCHESTER,
JANUARY 1, 1772.

E S S A Y I.

T H E

E M P I R I C

O R

M A N O F E X P E R I E N C E,

BEING ARGUMENTS AGAINST THE USE OF

THEORY AND REASONING IN PHYSIC. (a)

*Sufficit si quid fiat intelligamus, etiamsi quomodo quidque
fiat ignoremus.* C I C E R O.

IN this polished age, when every art is advancing towards perfection, and every science enlarging its boundaries, it is a melancholy consideration that MEDICINE should alone be left behind, in the general career of improvement.

The

(a) THIS and the following dissertation contain a discussion of the arguments for and against the use of theory and reasoning in medicine. They are not intended as an explanation of the tenets of those two ancient and celebrated sects of physicians, the Empirics and Rationalists, of which Celsus hath given us so elegant an ac-

The mists of ignorance and error are now vanishing before the lights of genuine philosophy; and knowledge, practical and speculative, extends its influence even to the meanest mechanic. But the Hippocratic art, amidst this rapid and almost universal revolution, is at least stationary, if it move not in a retrograde course. And what is singular in its fate, the same causes which have promoted the advancement of the sister sciences, have, by a wrong direction, checked the growth, and retarded the progress of one, which is

—— fairly worth the seven.

POPE.

THE industry of its professors, by an injudicious application, hath served only to darken and perplex it. Instead of patiently treading in the sure steps of EXPERIENCE, they have followed the false clue of

count; but to point out opinions which now prevail in the world, and which naturally arise from the different lights, in which the same subject is viewed by different minds. The author hath endeavoured to suppose himself first of the one party, and then of the other; in order more fully to enter into the sentiments of each, and by that means to do justice to both sides of the question. In this kind of writing it is not easy to avoid declamation; and he hopes to be excused, if he has indulged some degree of that enthusiasm, with which two antagonists may be supposed to be actuated, when pleading against each other, in support of a favourite cause.

THEORY;

THEORY; and whilst, with infinite pains and labour, they endeavour to penetrate into the recesses of physic, they have lost themselves in the labyrinths of error. Unhappily for the healing art, their mistakes have coincided with the common propensities of mankind, who are more inclined to search after hidden and undiscoverable causes, than to attend to the obvious phænomena of nature. Blinded with their own fictions, these wanton theorists conceal their ignorance from themselves and the world, by unmeaning terms and pompous phrases.

“ Omnia enim stolidi magis admirantur amantque

“ Inversis quæ sub verbis latitantia cernunt.”

LUCRETIVS.

BUT descending from the flights of declamation, let us point out the folly, detect the fallacy, and trace the dangerous consequences of theory and reasoning in medicine.

WHOEVER searches into the annals of physic, cannot fail of being astonished at the almost infinite variety of systems and hypotheses, which at different times have been obtruded on the world. The amazing fertility of the imagination is there displayed in its full extent; and perhaps so ample an exhibition of the powers of human invention might gratify the vanity of man, if the agreeable effect were not more than counterbalanced by the

humbling view of so much absurdity, contradiction, and falsehood. The idlest opinions have had their abettors; the most groundless fictions have been swallowed with credulity. A list of all the follies which, at different periods, have been established as articles of faith in medicine, would form the severest satire on the healing art. Who can withhold his laughter when he reads of expelling, attracting, and concocting faculties; of energies, sympathies, antipathies, idiosyncrasies, and occult causes; of the body being nothing but salt, sulphur, and mercury; of man being a microcosm, and uniting in his frame the motion of the stars, the nature of the earth, of water, air, all vegetables and minerals, the constellations, and the four winds. Yet ridiculous as these several tenets may appear, they have given rise to sects, have been espoused with warmth, and defended with acrimony. But the excentric genius of the theorists hath not been confined within the limits of physiology, and the laws of the animal œconomy: the hidden causes of diseases, the elements or first principles of medicines, and their secret mode of action on the body, have afforded another no less extensive field for the exercise of their creative imaginations. The bare recital of their fictions, would sufficiently demonstrate their absurdity. But to enumerate them would be an almost endless task. Erasistratus defines disease to be a translation of blood from
the

the veins to the arteries; whereas Galen asserts that, as health consists in the equilibrium between dryness and moisture, heat and cold, sickness must depend upon the subversion of that equilibrium. One sect adopts *plethora* as the cause of all diseases; another denies the possibility of its existence in the body. Sylvius exults in the discovery that an acid is the sole morbid principle; his antagonists ascribe that honour to their alkali. Salt, sulphur, acrimonies, caustics, volatiles, ferments, &c. &c. have each, at different times and by different systems, been received as the undoubted *principia morborum*. No less absurd are the fictions of the theorists, concerning the elements and qualities of medicines, and their operation on the body. The same drug is represented as hot in one degree and cold in another, or as dry in one proportion and moist in another. Certain remedies are whimsically assigned to particular parts of the body, on which they are supposed to exert their effects by a peculiar predilection. Hence the classes of pectorals, stomachics, hepatics, cephalics, cordials, &c. One medicine attracts and eliminates the bile, another the *pituita*, and a third the *atra bilis* or melancholy. Some preparations *irradiate* the animal spirits, others *darken* and *obscure* them. But enough of these idle conceits, the offspring of theory, and the disgrace of physic!

PERHAPS it may be objected, that though many vain and groundless hypotheses have been advanced, there are two which will bear the test of ridicule, and which have had the suffrages of the wisest and most learned men in their favour. Let us briefly examine their pretensions to credibility.

I. GEORGE ERNEST STAHL, a German physician, of a subtil and metaphysical genius, supposes two opposite principles or propensities in the human frame; one constantly and uniformly tending to corruption and decay, the other to life and health. The former is founded on the elementary composition of the body, the latter depends on the power and energy of the mind. By means of the nerves, the influence of the mind is extended to every part of the system, and if their action be impeded, disease is the unavoidable consequence. A superabundance and spissitude of the blood is therefore the proximate cause of sickness, as the energy of the mind is thereby diminished, and its action on the body obstructed. Hence to lessen the quantity, and break down the *lensor* of the blood, the soul exerts all its powers and excites hemorrhages, sweats, diarrhœas, fevers, and the like. Dr. Porterfield and Dr. Nichols have carried this theory still further. The latter, in his prælection *de anima medica*, affirms without reserve, that the soul at first forms the body, and afterwards governs

governs it; that she regulates and conducts all its vital and natural motions; circulates the fluids and distributes them to the different parts of the system, with such velocity and in such proportion as she judges right; and that whenever the body is disordered, she excites those conflicts and commotions, which are best adapted to restore it to health and soundness.

SUCH are the principles of the Stahlians.—Let the unprejudiced judge whether they need a serious refutation. Could a mariner plan and construct a ship, launch it into the wide ocean, govern it in storms, direct it from shoals and rocks, and steer it safe into the destined harbour, without being conscious of the skill he exerts, and the labour he employs? The analogy is obvious; and it would be equally absurd to suppose that the mind could form the body, regulate all its motions, superintend its health, rescue it from disease, and be perpetually occupied in planning and executing the wisest designs, without the least knowledge or consciousness of the power and energy she every moment exerts.

BUT the first proposition of the Stahlians confutes itself. For if the body and mind, with equal force, be constantly and uniformly tending different ways, no change can possibly ensue; agree-

ably to the well known axiom in physics, that action and reaction are equal, and destroy each other's effect. Not to insist however on this error in philosophy, the doctrine of the Stahlians in confining all diseases to *lentor* and *plethora* is false and absurd. The dropsy, scurvy, *cacochymia*, jaundice, putrid fevers, and many of the nervous class of ailments, are accompanied for the most part with a thin and colliquated state of the fluids. Nor is there more truth in the assertion, that every distemper is an effort of the mind to relieve the body. The slightest laceration of a tendon has been succeeded by the locked jaw, convulsions, and death. An indolent glandular tumour terminates not unfrequently in a cancer. A neglect to evacuate the bladder in due time hath occasioned a suppression of urine; and the palsy has been the consequence of a profuse hemorrhage. Are these then the wise conflicts of the soul, to rescue her suffering partner from impending evil! And must we view in the same light the *angina maligna*, the *tussis convulsiva*, the spasmodic colic, the *tetanus*, *catalepsis*, worms, rickets, &c. &c. No one but a theorist, blinded with the mists of his own brain, would answer in the affirmative.

2. THE important discovery of the circulation of the blood, in the beginning of the last century,
by

by the ever memorable Dr. Harvey, gave rise to the introduction of MECHANICS into medicine. And as that system of philosophy was founded on the general laws of nature, it was obvious to infer its application to the human body; which was supposed to differ only from the universe of things, in the wonderful variety and complication of its machinery. Bellini, Borelli, Pitcairn, Keil and Boerhaave are the great supporters of this theory. According to the description of the latter, the body is chiefly composed of a conic, elastic, inflected canal, divided into similar lesser ones proceeding from the same trunk, which being at last collected into a retiform contexture, mutually open into each other, and send off two orders of vessels, lymphatics and veins, the one terminating in different cavities of the body, the other in the heart. These tubes are destined for the conveyance of the animal fluids; in the circulation of which life consists, and on whose free and undisturbed motion health depends. *Obstruction* therefore is the proximate cause of most diseases. And as it is produced either by a constriction of the vessels, or by a *lentor* in the blood, these are considered as the remote causes.

HOWEVER plausible this theory may appear to be at first sight, it will be found, on a stricter examination, to be fallacious and defective. The
mathematician

mathematician, who calculates the projectile force of the heart, the velocity of the blood in the arteries, and the various secretions of the glands, from the known laws of fluids in motion, and the nature of tubes of different shapes and sizes, must unavoidably be exposed to a thousand mistakes. The vessels of the body are too numerous and minute to admit of an accurate mensuration; and they are perhaps every moment undergoing changes, from the diversified action of that vital power which animates our wonderful system. Hence arises the contrariety in the computations of philosophers on this subject. Borelli reckons the resistance which the heart overcomes, in propelling the blood through the arteries and veins, to be equal to 180,000 pounds weight: Dr. Hales makes it amount to no more than 51 pounds; and Keil, though he computes the fluids of the human body to be five times more in quantity than Borelli supposes, hath reduced the sum to a single pound. One asserts that the pressure of air, overcome in ordinary respiration, is equivalent to the weight of 14000 pounds; a second proves it to be equal only to a 100 pounds; and a third makes it so inconsiderable, as to be almost below comparison; whilst all the three appeal to mathematical demonstration. A similar diversity appears in the conclusions of the mathematicians, concerning the quantity of bile separated by the liver.

liver. To determine this point, Borelli first measures the diameter of the *ductus communis choledochus*, which he finds to be the 225th part of the diameter of the *vena cava*, just before it enters the right auricle of the heart. Hence he infers that if 7680 pounds of blood (supposing the whole mass to be twenty pounds, and to circulate sixteen times every hour) passes through the *vena cava* in twenty-four hours, the 225th part of this quantity, i. e. thirty-four pounds of bile must, in the same space of time, be transmitted through the hepatic ducts: a conclusion altogether repugnant to fact and experience. And it will appear to be much more so, if we admit, with the latter mathematicians, that the vessels of the human body contain at a medium thirty pounds of blood; for then the quantity of bile, according to Borelli's method of reasoning, must amount to eighty-five pounds in one day. But in this, as in the former instance, Keil widely differs from Borelli, and with greater probability concludes that two drachms of bile and no more, are hourly separated from the liver. In these calculations no attention is paid to the peculiar nature of the animal fluids. Water and wine, a poisonous and wholesome liquid, are governed by the same hydraulic laws, but their effects when circulating in the body would certainly be very different. We know, from experience, that the velocity of the pulse is

influenced

influenced by the state of the blood. Even the accession of new chyle, after each meal, quickens the action of the heart and arteries. The human body therefore is not to be considered as a mere machine; and that theory which is built on this foundation is evidently fallacious. (*b*)

BUT the mechanic hypothesis is also inadequate and defective; for the animal frame is incident to numberless diseases which have no dependence on obstruction. The *morbi fibræ debilis et laxæ* are not, even by Boerhaave himself, ascribed to this cause. The dropfy, scurvy, putrid fevers, small-pox, measles, and *lues venerea* are inexplicable on mechanical principles. The *hydrophobia* seems to be entirely a nervous affection, and cannot with the least propriety be supposed to arise from obstruction. No inflammation is observable on dissection in the fauces or gullet; nor is there any palsy in the muscles subservient to deglutition. A numerous class of diseases depend upon that sympathetic connexion, which subsists between different

(*b*) In the Philosophical Transactions there is a table, in which the several purgatives and emetics, commonly in use, are enumerated and adjusted by mathematical rules to all ages, sexes, and constitutions. The doses of the medicines are as the squares of the constitutions. And in the Edinburgh Medical Essays there is a formal attempt to correct the errors of this table.

parts of the body. When the stomach is out of order, languor, debility, watchfulness, the night mare, and sometimes a *cephalæa*, *vertigo*, or *hemisphæria* are the consequences. A rough bone stimulating the nerves of the great toe, hath produced epileptic fits. And it is well known that children, from the irritation of the gums in dentition, are liable to vomiting, purging, fever, and convulsions. These few instances are sufficient to shew that the body is unhappily subject to many disorders, besides those which proceed from obstruction. And perhaps the conclusion may be carried still further, when we consider that in the operation for the aneurism a large artery is tied up, and the circulation of the blood for some time almost totally suppressed in the part, without any material injury to health. Morgagni relates that Valsalva affixed two ligatures to the carotids of a dog, who lived above twenty days after the operation, and might have continued longer, if he had not been killed for the purpose of dissection. Is it then to be supposed that the obstruction of a few capillaries, which are united together by an infinite number of anastomosing branches, can be productive of such fatal consequences, whilst the course of the blood is stopped in large vessels with impunity? Equally false and absurd is the mechanical hypothesis, concerning the operation of medicines, which is supposed to depend upon the size, figure,

figure, and gravity of their constituent particles. Thus chalybeates, for example, are recommended in obstructions of the *catamenia*, on account of the *momentum* which they communicate to the blood. And on the same principles, mercury is said to break down the texture, and produce a colliquation of the animal fluids. But both these explanations, however elegant in theory, are false in fact. From the experiments of the late Dr. Wright (c) it is evident that steel never enters the lacteals, and that it exerts its effects solely on the stomach and bowels. And it is surely beyond the bounds of credibility to suppose, that a few grains of corrosive sublimate, which are light enough to be suspended and dissolved in brandy, are capable, by their extraordinary weight, of dissolving the *crassamentum* of the blood. But it is the genius of theory to dignify trifles, and to ascribe the most wonderful effects to the most insignificant causes.

HAPPY however had it been for the world, if the medical systems, which have been obtruded on it, were only chargeable with inutility, absurdity, or falsehood. But alas! they have misled the understanding, perverted the judgment, and given rise to the most dangerous and fatal errors in practice. A short view of the history of physic

(c) Phil. Transf. vol. L. part II. p. 595.

will convince us of this melancholy truth. The divine Hippocrates knew how to distinguish between theory and experience; and he suffered not his doctrines of fire and water, his elements with their powers, nature with its inclinations, aversions, attractions, repulsions, and ratiocinations, to influence his treatment of diseases. But the conduct of his successors was widely different.

ERASISTRATUS reasoning on false and precarious principles, and neglecting experience, the sole test of utility, proscribes the use of venæsection and purgatives, and condemns them as remedies equally infamous and dangerous.

ASCLEPIADES, from whom the modern sect of mechanics have borrowed many of their doctrines, supposing that health depends on the just proportion between the pores of the body and certain corpuscles, which they are destined to receive and transmit, and that it is impaired whenever these corpuscles are obstructed in their passage, orders exercise on horseback in the most ardent fevers. He advances it as a maxim, that one fever is to be cured by raising another; and that the strength of the patient is to be exhausted by watching, and the endurance of thirst. And his practice was strictly and severely conformable to his principles; for he would not allow the sick to cool their mouths with a drop of water, during the two first days of
the

the disorder. But he indulged his phrenitic patients in the use of wine, even to intoxication.

THEMISON, the disciple of Asclepiades, rejected some of the opinions of his master, and founded a new sect, called the Methodics. But his practice did not materially differ from that of Asclepiades, and his success is recorded by Juvenal in the following line :

Quot Themison ægros autumnno occiderit uno.

GALEN for the most part followed the plan of Hippocrates, in the treatment of diseases. But as the *materia medica* in the course of five hundred years had been much augmented, the prescriptions of Galen were devoid of the Hippocratic simplicity. And it is more than probable that his false and ridiculous theory, concerning the primary qualities of hot and cold, dry and moist, led him into dangerous errors in the composition of medicines.

ORIBASIIUS, Ætius, Alexander, Trallianus, Paulus Ægineta, and their successors the Arabian physicians, attempted no material innovations, but humbly trod in the footsteps of Galen. The Arabians indeed introduced several new and valuable medicines into practice, such as manna, fenna, tamarinds, cassia, and rhubarb. And by the cultivation of chemistry, they laid a foundation for the
greatest

greatest and most important revolutions in the art of medicine. I omit the mention of Albertus Magnus, Arnoldus de Villa Nova, Raymund Lully, Johannes de Rupefciffa, Isaac and John Hollandus, and Basil Valentine, who were all chemists, many of them inventors of *panaceas*, and probably the authors of much mischief. In the beginning of the sixteenth century, Paracelsus, a native of Switzerland, stood forth, and with matchless arrogance, and the most supercilious contempt of others, proclaimed his opinions to the world. Seated in his Professorial chair at Basil, he solemnly burnt the writings of Galen and Avicenna, intending to become himself the sole oracle in physic. But his theory is wild, romantic, absurd, and dangerous; a ridiculous mixture of magic, astrology, and chemistry. The body, he says, is composed of salt, sulphur, and mercury; and in these three first substances, as he terms them, health and diseases consist. The mercury, in proportion to its degree of volatility, produces tremors, mortifications in the ligaments, madness, phrensy, and delirium. Fevers, phlegmons, imposthumations, and the jaundice, are the offspring of the sulphureous principle; and the colic, stone, gravel, gout, and sciatica derive their origin from salt. What fatal errors, in the treatment of diseases, must such idle notions of their causes unavoidably produce? The medicines which Paracelsus and

his followers employed, were generally metallic preparations, which, in such rash and presumptuous hands, were doubtless frequently pernicious, and always dangerous. Their common purge, in every disorder, was *mercurius præcipitatus*, reduced to pills, and made up with the *theriaca* or *mithridate*. About a century after Paracelsus, Van Helmont took the lead in physic; a man of such indefatigable industry, that he spent fifty years in torturing, by every chemical experiment the animal, vegetable, and mineral kingdoms. He was a person of learning and ability, but, like his predecessor, had the folly of pretending to an universal remedy (*d*). By his writings he defended, enlarged, and promoted the chemical theory; and as Sylvius de la Boe, and Otho Tachenius soon after adopted his system, it became almost universal. All the operations of nature, in the world at large, as well as in the animal œconomy, were reduced to the laws of chemistry; and every phænomenon was accounted for, on the principles of fermentation, putrefaction, corrosion, effervescence, solution, or mixture. The functions of the body

(*d*) Veteres chemici, quorum interpres est Helmontius, dixerunt, in cuprum insitum esse genium metallicum, qui vix mole corporea, sed tantum irradiatione sanat omnes ferè morbos; et Helmontius dixit, hoc fieri solo attactu tincturæ cupri ad linguam.

Boerhaave de morb. Nervor. p. 764.

were

were explained by analogies, drawn from chemical experiments. Thus the solution of the aliments in the stomach was ascribed to an acid, because acids were observed to dissolve metals, and other substances of the firmest texture. Muscular motion was accounted for, by an effervescence and explosion, in the imaginary rhomboidal receptacles, resembling the tumults raised by the mixture of an acid and an alkali. The generation of animal heat was imputed to the combination of the acid chyle, with a supposed balsam of the blood, because a similar effect is produced by uniting acids with distilled oils. If the acid of the chyle happen to be highly concentrated, and the juices very acrimonious, according to this theory, an ardent fever is excited. The cold fit of an intermittent was ascribed to the action of nitre, sea salt, or sal ammoniac in the blood, because these substances were found to refrigerate water, in a remarkable degree.

FROM this absurd and groundless theory, the practice of the chemical sect was deduced; of which I shall give one memorable and fatal instance. In the year 1669, an epidemic fever raged at Leyden, and carried off more than two thirds of the principal inhabitants of that city. The symptoms which accompanied it were a disordered stomach, vomitings, anxiety, quotidian or tertian paroxysms, spots, oozing of blood from

different parts of the body, dysenteric stools, foetid urine, great debility, apthæ, and other appearances, which indicated a very high degree of putrefaction. But Sylvius de la Boe, who was at that time a Professor in the University of Leyden, ascribed the distemper to a prevailing acid, and attempted the cure of it by absorbents, and other medicines of a septic nature; to which injudicious practice, we may justly impute a considerable share of that uncommon fatality, which attended the progress of this fever. And is it not more than probable that the present practice, of giving the *testacea* in acute distempers, hath a dangerous and pernicious tendency? If acidities prevail in the *primæ viæ*, they will indeed correct them; but with this inconvenience, that they generally occasion costiveness. And if they remain unneutralized in the first passages, they will powerfully promote putrefaction, and by concreting with the mucus of the stomach and bowels, prove highly oppressive and injurious.

I HAD almost omitted to mention a theory, of the most dangerous tendency, which the chemists adopted from Galen, and enriched with many absurd additions of their own invention. They supposed the body to be endued with certain *animal spirits*, as they were called, generated in a manner, similar to that of obtaining brandy from wine by distillation. These spirits were considered

sidered as the seat of various diseases, particularly of inflammations; and were thought capable of being infected with *something* of a peculiarly deleterious nature. Hence it became a *desideratum*, to expel this unknown enemy out of the system; and as it was observed, that acute distempers are sometimes terminated by a critical sweat, it was concluded, that the most powerful sudorifics were the best means of accomplishing this desirable end. This gave rise to the destructive and fatal practice, which soon became universal, of administering heating remedies, in diseases of an inflammatory nature; a practice productive of great devastation amongst the inhabitants of Europe. Sydenham, the English Hippocrates, was the first physician who had understanding and courage enough, to stem the rapid and overwhelming torrent: and we are now at last taught, by sad experience, founded on the destruction of numbers of our fellow creatures, that the cooling regimen is alone to be employed, in such distempers. The small-pox affords us a remarkable example of the opposite effects of the two different methods of treatment. And the amazing success which hath attended the new mode of inoculation, is a proof, undeniably convincing, of the excellence and safety of the one, and of the danger and frequent fatality of the other. So powerful is the action of heating remedies, in this disorder, that a single glass of

mountain wine, given even after the eruption is completed, is said to have produced an additional number of pustules.

THE system of Stahl, which succeeded that of the chemists, though false and absurd, is not chargeable with any pernicious tendency. As it chiefly relates to the influence of the mind over the body, the doctrine of diseases which it inculcates is simple, and the indications of cure which it furnishes are few, and at least harmless. Thus when the soul, in her efforts to relieve the body, runs into excess, and excites an immoderate hæmorrhage, *diarrhæa*, or fever, she is to be checked and restrained. On the contrary, when she acts negligently, or too feebly, she is to be roused and stimulated to an exertion of her powers. In these instances, the conclusions of the Stahlians, though deduced from groundless principles, are certainly just, and their practice is supported by experience, the true standard of fitness and propriety in physic.

THE Mechanic Theory, though better supported than the Stahlian, hath a more dangerous influence on the treatment of diseases. Thus for example, in the management of the small-pox, a physician, who is strongly attached to the system of obstruction, and regardless of experience, might commit the most fatal

fatal errors. As the distemper, according to the mechanical hypothesis, consists in a certain matter thrown off from the blood, and locked up in the capillaries of the skin, where being gradually accumulated, it forms pustules; he would probably attempt, either to disperse it by repeated purging and venæsection, or to promote its passage through the small cutaneous vessels, by the most powerful sudorifics. The first method of cure would occasion a sudden sinking of the pocks; the second would render them putrid, confluent, and malignant. And thus the unfortunate patient would fall a sacrifice to reasoning and theory. I mean not, by this illustration, to charge the mechanic sect, with having adopted so dangerous a method of treating the disease under consideration. The plan of cure, prescribed by Boerhaave, is judicious and successful; but it is a deviation from his favourite hypothesis of obstruction, and is founded on experience and observation. There are however some fatal instances, in which the mechanical systematics have regulated their practice by their theory. How many unhappy wretches fell by the lancet, or sunk under the operation of cathartics, in the ulcerated sore throat, till the sagacious Fothergill pointed out the true nature and right management of that disease? It is not long since crude mer-

cury was considered as a *panacea*, and taken universally, by the healthy, as well as the sick, to prevent obstructions in the one, and to break down by its gravity those which were already formed in the other. On the same principle, the spirit and salt of hartshorn were exhibited indiscriminately, in almost every ailment; for as they colligate the blood, when taken out of the body, it was not doubted but they would dissolve that lentor of the fluids, which was, and is still by many, regarded as the most general cause of diseases.

It is evident then, that THEORY is absurd and fallacious, always useless, and often in the highest degree pernicious. The annals of medicine afford the most striking proof, that it hath, in all ages, been the bane and disgrace of the healing art. And as it favours the indolence, flatters the vanity, and gratifies the curiosity of man, ever inquisitive after causes, I fear the passion for it will not be easily suppressed, amongst the professors of medicine. The invention of an hypothesis is a work of no difficulty to a lively imagination; and the fiction, by its tinsel glitter, never fails to dazzle the ignorant and vulgar. But to watch with close attention the operations of nature, to treasure up a store of useful facts, to learn, by accurate observation, the diagnostics of diseases,
and

and by unbiaſſed experience, the true method of cure, requires unwearied labour, aſſiduity, and patience, at the ſame time that it admits of no pompous diſplay of wit or knowledge. The wiſe, however, value not genuine ſcience leſs, for her unaſſuming deportment and ſimplicity of attire ; and the opinion of the ignorant would be unworthy the conſideration of a judicious phyſician, if humanity did not intereſt him in the concerns of ſuch numbers of his fellow creatures, as unhappily fall under that denomination.

E S S A Y II.

T H E

DOGMATIC, OR RATIONALIST;

BEING ARGUMENTS FOR THE USE OF

THEORY AND REASONING IN PHYSIC.

Medicina, in philosophia non fundata, res infirma est.

BACON.

THOUGH reason is the most exalted faculty of man, and the source of that high rank which he holds, in the universe of God, there is a set of groveling spirits in the world, who vilify the powers of the understanding, and with inverted pride, glory in sinking themselves to a level with the brute creation. Of this class are the EMPIRICS, who have laboured with infinite pains, to banish all theory and reasoning from the art of medicine. Experience, they affirm, is the sole guide to safe and successful practice; and fatal is the temerity of those, who deviate from the beaten path,

path, and trust in any instance to the direction of their understandings. The proximate cause and hidden nature of diseases are beyond our ken, and it is equally absurd and useless to attempt their investigation. All that is necessary to their cure is plain and obvious, and requires no deep or philosophical researches. We know the aliments, to which the human body is incident; we are acquainted also with a variety of active remedies; and *nature* alone hath taught us to adapt the one to the other. Thus argue the Empirics; with a sagacity adequate to the rank of beings, to which, by their contempt of reason, they degrade themselves. The subject, however, is worthy of an attentive examination.

THERE are two methods of acquiring experience in the art of medicine; one, by reading, the other, by practice. The first opens to our view a wide and almost boundless scene of knowledge, presenting us with the lore of all preceding ages: the last is limited and confined, and furnishes a very scanty harvest of instruction. Both are necessary to form the skilful and expert physician; but without the concurring assistance of our judgment and understanding, neither of them will be found of any other avail, than to perplex us with uncertainty, and to lead us into error.

WHOEVER

WHOEVER sits down to study the volumes, ancient and modern, which have been written on the subject of medicine, will be amazed at the multiplicity, and confounded with the contrariety of the facts and observations which he meets with. And if he read with no other view, than to inform himself of the experience, and blindly to submit to the direction of his predecessors in the healing art, he will either remain in perpetual doubt and suspense, or will treasure up an indigested mass of contradictory materials, burdensome to his memory, and unfit for use. An undistinguishing credulity is, in no science, so absurd and dangerous as in physic. Here every fact, which is advanced, should be examined with accuracy, and admitted with caution. The histories of diseases are frequently the records of falsehood; at least they contain such a mixture of error and truth, as requires the exertion of reason, and an extensive knowledge of the animal œconomy, to separate the one from the other. Still more dubious and uncertain is the therapeutic part of medicine, which hath been subject to all the vicissitudes of fashion, and regulated by the follies, prejudices, and passions of men. How many *panaceas* have been obtruded on the world, whose miraculous effects have ceased the moment they became known!

known! Every author hath his favourite remedy; and what he extols, perhaps another may condemn; each pleading in his own behalf the testimony of experience. The annals of physic abound with instances of this kind: thus Hippocrates, Galen, Sydenham, and Boerhaave, with numberless other inferior names, are enlisted on the side of venæsection; whilst Erasistratus, Paracelsus, Van Helmont, and the Cartesian sect, totally banish it from the circle of practice. A similar fate hath attended the other means of evacuation; and purgatives and emetics, at different times, have been strongly recommended, or ignominiously proscribed. Antimony was formerly considered as a poison, and its use was forbidden by a public edict at Rome; whereas now it is employed under various forms, and constitutes one of the most valuable articles of the *materia medica*. The Peruvian Bark, soon after its introduction into Europe, met with the most powerful opposition. Numberless mischiefs were ascribed to its operation, and cases recited wherein its effects were said to be obviously pernicious. Even those who thought the most favourably of it, regarded it as a dangerous though efficacious medicine, and never administered it, but with caution and reserve. At present it is given in the largest doses,

doses, and in such a variety of disorders, that it is become an almost universal remedy. Opium, steel, and mercury have also undergone their several revolutions, and the most contradictory testimonies may be collected, concerning their nature and effects. These few instances (for many more might be adduced) sufficiently prove the absurdity of blindly adopting the experience of *others*; and it will be found, on examination, that *our own*, without the assistance of theory and reasoning, is no less exposed to uncertainty and error. The diseases, to which the human body is obnoxious, are so various, and frequently so complicated with each other, that it requires the clearest judgment to distinguish them with accuracy, and the nicest skill to treat them with propriety. Their symptoms are to be weighed with attention, separately as well as collectively; the temperament, age, and sex of the patient are to be considered; and the remote, and occasional causes of sickness, to which he may have been exposed, are to be examined into, before any conclusion can be drawn concerning the *genus* of the ailment, or the indications of cure. In the application of remedies, regard is to be had to the nature, internal source, and period of the distemper, and to the peculiar habit or idiosyncrasy of the sick person. But
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this implies the exercise of reason, and, besides experience, requires a knowledge of the structure and functions of the animal frame, of the changes produced in it by disease, and of the powers and qualities of medicines; all which the empiric rejects as visionary and useless. “In a watch every one observes when the “finger deviates; but the artist alone, who is “acquainted with the exquisite structure of the “machine, can correct and amend its movements.” A constant and diligent attendance on the sick may instruct us in the external face of diseases, and enable us, with some degree of certainty, to prognosticate their issue. But without theory, and an exertion of our rational faculties, it will never furnish any other than the mere fortuitous means of relieving them. The savage Indian, by his accurate observation of natural signs, can frequently foretell those tremendous storms, to which America, at certain seasons, is exposed: But of what avail would this have been, in preventing the impending ruin, if philosophy had not accomplished what was impossible to rude experience? To the ingenious Franklin, our colonies owe the warmest gratitude; who by investigating the nature and causes of thunder and lightning, hath pointed out the method of warding off their destructive effects. How blind and dangerous

gerous would be all attempts to cure the disorders of the eye, without a knowledge of its structure, and an acquaintance with the theory of vision! And yet the empiric is, professedly, ignorant of both. Suppose him to be consulted by a patient labouring under the *gutta serena*: No external defect appears, no pain is complained of, and the health of the body, in every other respect, is perhaps unimpaired. By what signs will he be able to determine the seat of the disease; or upon what principles will he proceed, in the treatment of it? Confusion, uncertainty, and danger must necessarily attend his random practice. By the laws of the animal œconomy, there subsists a certain sympathy between different parts of the body; by which the disordered state of one organ impairs the functions of another. The head and stomach, for instance, have an almost universal consent with the rest of the system, and, of consequence, are subject to various, and sometimes opposite causes of indisposition, each indicating a different and peculiar method of cure. Thus watching, flatulency, indigestion, the gout, rheumatism, or inflammation may produce the head-ach; and sickness or vomiting may arise from surfeiting, from a load of mucus, from putrid bile, from an affection of the kidneys, and from many other sources.

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In all these cases the empiric, if he act consistently with his principles, will attend only to the leading symptom, and will indiscriminately apply his stomachic cordial, or cephalic plaister, without any regard to the origin or nature of the malady.

MAY we not therefore justly conclude, that mere experience, whether derived from books, or acquired by personal observation, is insufficient of itself to qualify us for judicious and successful practice. “I look upon a good physician,” says the amiable Mr. Boyle, “not properly as a servant
“to nature, but as a counsellor and friendly assist-
“ant, who in his patient’s body furthers every
“thing, which he judges to be conducive to the
“welfare and recovery of it.” To this end, a knowledge of the animal œconomy, of the influence of external causes on the human frame, of the state of health, and the changes induced by disease, is absolutely necessary. And this is the foundation, on which the Rationalist erects the superstructure of medicine. He explores the writings of the ancients and moderns, he attends diligently to nature in her operations, he selects and arranges facts, and deduces general conclusions, and thus forms a consistent, rational, and useful theory, on which his practice is built (*e*). He neither in-
dulges

(*e*) ALTHOUGH the arguing from experiments and observations, by induction, be no demonstration of general
D
neral;

dulges a warm and creative imagination, nor yet confines himself within the limits of one narrow hypothesis, well knowing the absurdity of either extreme. With the Stahlans he believes that the soul, or nature, as it is now called, frequently exerts herself in the cure of diseases, or in expelling from the body whatever is offensive and hurtful. Thus a *crapula* occasions a *diarrhœa*, and a crumb of bread, in the wind-pipe, excites a fit of coughing. But he is aware likewise, that the efforts of nature in such cases may be too powerful; that a salutary *diarrhœa* may terminate in a dysentery, and a fit of coughing in universal convulsions. He adopts also, with restrictions, the mechanical and chemical hypotheses, and admits that obstruction is often a cause of disease, and that many changes in the body are reducible to chemical and mechanical principles, of which he deems inflammation and acrimony to be sufficient proofs. But he is not wedded to systems, nor anxiously bent upon explaining every phænomenon, which occurs in the animal frame. He diligently avails himself indeed of all the assistances, with which philosophy furnishes the healing art; but sensible of its im-

neral conclusions, yet it is the best way of arguing which the nature of things admits of; and may be looked upon as so much the stronger, by how much the induction is more general. NEWTON.

perfection,

perfection, he ingenuously acknowledges, that in diseases there are numberless anomalous symptoms, that the operation of medicines is often irregular and uncertain, and that even in the healthy body, there are many appearances, which are inexplicable to the wisest and most experienced of the faculty. But where his theory is deficient, his practice is proportionably more cautious and reserved. If experience fail him, he calls in analogy to his aid (*f*); and judges it better to pursue a doubtful path, than to stand still in uncertainty and suspense. In the most intricate cases, however, he is not totally without a clue: Reason and philosophy are his guides; and under such direction, there is at least a probability that he will not mistake his course. And by thus treading occasionally in unbeaten tracks; he enlarges the boundaries of general science, and adds new discoveries to the art of medicine. In a word, the Rationalist has every advantage which the Empiric can boast, from reading, observation, and practice, accompanied with superior knowledge, understanding, and judgment.

(*f*) Ejus (analogiæ) hæc vis est, ut id quod dubium est, ad aliquod simile, de quo non quæritur, referat; ut incerta certis probet.

Quint. Inst. Orat. l. 1. c. 6.

E S S A Y III.

EXPERIMENTS AND OBSERVATIONS

O N

ASTRINGENTS AND BITTERS.

S E C T I O N I.

EXPERIMENT I. **A**N ounce of PERUVIAN BARK, coarsely powdered, was divided into two equal parts, one of which was infused forty-eight hours, in six ounces of cold spring water; the other was boiled over a slow fire forty minutes, in nine ounces of water, till about a third part of the water was evaporated. The infusion and decoction were each filtered through linen rags doubled, and of the same fineness.

FOUR grains of *sal martis* were dissolved in an ounce of spring water, and one drachm of this solution was added to equal quantities (viz. half an ounce) of the turbid decoction and infusion. Each assumed a deep purple colour, scarce perceptibly different in degree, though I thought the
infusion

infusion, after standing a while, acquired rather a more dusky purple than the decoction. The infusion had a deeper tinge, and more of the taste and smell of the bark in substance than the decoction: Its taste indeed exactly resembled the bark, after it has been broken down, and chewed for some time, in the mouth.

EXPERIMENT II. Equal quantities of each *residuum* were boiled over a slow fire, in three ounces of spring water, for the space of twenty minutes. The decoctions were equally turbid, exactly similar in taste, and on the addition of the chalybeate solution, in the proportion of one drachm to half an ounce, they assumed precisely the same colour, viz. a dusky brown, like chocolate, but inclining somewhat to purple.

EXPERIMENT III. Five drachms of each *residuum* were infused, for the space of forty hours, in an ounce and an half of Jamaica rum, which was sufficiently pure, and unimpregnated with any astringent matter from the cask. The tinctures were exactly alike in taste and colour; and, on the addition of one drachm of the chalybeate solution, they were instantly changed from a deep red, to a dark and dirty brown, which was precisely the same in both tinctures.

EXPERIMENT IV. To half an ounce of powdered bark, was added an ounce of cold spring water. The mixture was well triturated in a

marble mortar, after which it was suffered to remain at rest, till the gross powder subsided. The clear liquor was then carefully poured off, and fresh water, to the quantity of half an ounce, was added; the trituration was renewed, and afterwards part of the *menstruum* poured off again, as before. This method was pursued for the space of thirty-four hours, in which time six ounces of water were combined with the bark. The mixture was then infused fourteen hours, without heat, and strained off. This infusion was found to have the smell and taste of the bark, in a considerably greater degree, than either the decoction, or the infusion without trituration, [Exper. I.] and it assumed a much blacker colour, on mixing with it one drachm of the chalybeate solution, than either of the two former preparations.

EXPERIMENT V. It was attempted to determine the comparative strength, or rather astringency, of five preparations of the bark, viz. the extract, decoction, cold infusion, tincture, and triturated infusion.

TEN grains of the extract, carefully made, and as free from *empyreuma* as this officinal preparation is generally found to be, were mixed with an ounce of hot water. But so imperfect was the solution, or to speak more properly,

properly, the suspension of the bark, that in a few minutes, a large powder was deposited at the bottom of the glass. This however was shaken up, and one drachm of the chalybeate solution was added to the mixture. The same quantity was added to half an ounce of the decoction, infusion, tincture of the London Dispensatory, and triturated infusion. The last assumed by far the deepest black, the extract approached nearest to it, and the tincture appeared to be the least tinged. The decoction and infusion were precisely alike in colour.

EXPERIMENT VI. The *residuum* of the triturated infusion, [Exper. IV.] was boiled over a slow fire, in three ounces of water, for the space of twenty minutes. The decoction, when cold, was strained off. It was of a paler colour than the decoctions mentioned in Exper. II. although there was a portion of powdered bark suspended in it, which, by the trituration, had been rendered fine enough to pass through the filter. This powder, on standing, subsided to the bottom of the vessel, and left the decoction much more limpid than it was before.

To equal quantities of this, and of the two decoctions mentioned above, one drachm of the chalybeate solution was added. The

black tinge was manifestly weakest in this decoction, though the difference was not so great, as might have been expected, from the diversity in their sensible qualities of taste and smell; owing perhaps to the fine powder of the bark, which floated in it, and retained some degree of its original astringency.

EXPERIMENT VII. Equal quantities of the simple, and of the triturated infusion, were boiled for the space of seven minutes, over a quick fire. Both lost their transparency, when cool; but the latter assumed a much more turbid appearance than the former, exceeding even that of the decoction from fresh bark, [Exper. I.] and after standing twenty-four hours, it deposited a very copious sediment.

EXPERIMENT VIII. Half an ounce of powdered bark was infused forty-eight hours, in five ounces of spring water, and one ounce of white wine vinegar. The mixture was placed near a warm fire, and at certain intervals was smartly shaken. It was then filtered through a linen rag doubled. The taste of the vinegar was in a good measure covered, though the smell was not; but the *menstruum* was not so fully impregnated with the flavour of the bark, as the infusion [Exper. I.]. One drachm of the chalybeate solution was added

to half an ounce of this acid infusion ; at first, no change of colour took place, but in a few hours a slight black tinge appeared.

EXPERIMENT IX. Half an ounce of powdered bark was well triturated, in the manner described in Exper. IV. with six ounces of warm water ; after which the mixture was poured into a bottle, placed near the fire, and frequently shaken. This process lasted forty-eight hours. The infusion, when strained off, was found to be more perfectly impregnated with the bark, than the triturated infusion with cold water, [Exper. IV.] as appeared by comparing their colour, taste and smell, and by the deeper black, which it instantly assumed on the mixture of one drachm of the solution of *sal martis*.

EXPERIMENT X. Half an ounce of powdered bark, and two drachms of stone quick lime, warm from the kiln, were rubbed together until they were thoroughly united ; then six ounces of spring water were gradually poured on, the powder and water were well incorporated by triture, and the mixture was set by, to infuse for twelve hours. Two ounces of it were then filtered through a double linen cloth : the remainder stood thirty-six hours longer, and was often agitated ; after which, it was strained off. The smell of the bark was almost

almost entirely covered in both the infusions, which were strongly impregnated with the lime, and had an extremely disagreeable flavour. The first was of a pale colour, and possessed but a slight degree of bitterness; the latter had a deeper tinge, and was equally bitter and nauseous. Neither of them struck a black colour with the chalybeate solution, which, as soon as it was added, occasioned the separation of a yellow sediment, that subsided, in a few hours, to the bottom of the glass. Compared with the triturated infusion, [Exper. IV.] these preparations appeared to be much weaker, both in colour and taste. The *residuum* did not sensibly effervesce with oil of vitriol.

EXPERIMENT XI. The decoction and infusion were found to be impaired in strength, after standing six or seven days; although it was the winter season, and the weather was severely cold. The infusion became paler coloured, and at the same time deposited a slimy sediment. The decoction, at the end of seven days, assumed an almost milky hue, and struck but a faint black with the chalybeate solution. The simple infusion also had lost much of its astringency; but the two triturated infusions were very little altered in that respect.

EXPERIMENT XII. To determine the time, requisite for obtaining a sufficiently strong impregnation of the Peruvian bark, in cold water; four infusions were prepared, by macerating equal quantities (two drachms) of the fine powder of the *cortex*, in four ounces of rain water (g). After two hours infusion, the first was filtered; the second after seven hours; the third after nineteen hours; and the fourth after forty-eight hours. The second infusion, which had been prepared by seven hours maceration, appeared by its taste, smell, colour, and by the hue, which it assumed on dropping into it a saturated solution of green vitriol, to be considerably more impregnated with the bark than the first, and to be equal in strength to the other two preparations. This experiment seems to evince that the *cortex* yields its virtues, in a short time, to cold water, and that it is unnecessary to continue the infusion longer than seven or eight hours.

PHYSICIANS in general agree, that the PERUVIAN BARK is most powerful in its effects, when taken in substance. But as the stomach is frequently

(g) The foregoing infusions of the bark would have been stronger, had they been made with the fine powder of the *cortex*; and they would have struck a deeper black with green vitriol, had a less quantity of the chalybeate been employed.

unable to bear it, and as many patients have an almost invincible aversion to it in that form, it is of importance to determine, in what preparations the virtues of this valuable drug are least impaired, and whether it may not be administered under a form, that is elegant, palatable, and at the same time sufficiently efficacious. The decoction of the bark hath always appeared to me, to be an injudicious preparation: For though the *cortex* is not a substance of much volatility (*b*), yet there is a certain *aroma* accompanying it, which the heat of boiling water cannot fail to dissipate (*i*); and consequently the medicine is deprived of one of its component parts, in which probably some

(*b*) ASTRINGENCY is perhaps not so fixed a quality in vegetables, as is commonly supposed; for I am well informed that artichoke stalks, by being gently dried in an oven, lose their property of striking a black colour with chalybeates.

(*i*) THE vapour, which exhales in the first coction, being caught in proper vessels, condenses into a limpid liquor, which smells strongly of the bark.

Lewis's Mat. Med. p. 431.

GENUINUS cortex, sapore satis grato, et aromatico-amaro est; odorem spirat peculiari modo mucidum, attamen suavem, gratum, et aromaticum; atque huic sensui, in corticis sinceritate deprehendenda, præ cæteris omnibus credere solco.

Morton. lib. I. p. 66.

share

share of its virtues resides. The bark likewise undergoes a decomposition by boiling; the resin is separated from the gum, and remains suspended in the watery *menstruum*. This renders its appearance inelegant, its taste nauseous, and, I should apprehend, must considerably diminish its efficacy. For as the virtues of the bark are strongest in its native state, they depend, in all probability, on its composition as a *mixt*; and must of course be impaired by the disuniting of its constituent principles. Intermittents have been cured by oak bark and gentian combined, when neither astringents nor bitters separately, had any effect. By the first, second, and third experiments it appears, that the *cortex* yields its virtues at least, as perfectly to cold, as to boiling water: And the simple infusion hath certainly many advantages over the decoction. It is a much more agreeable and elegant preparation, and the principles of the bark remain perfectly unaltered in it, retaining the same proportions to each other, as in the substance of the drug itself. Nature hath so accurately combined, and blended together the gummy and resinous parts of the *cortex*, that by their union, they become soluble in *menstrua*, with which, when separated, they refuse to unite. Thus they reciprocally promote the solution of each other in water and ardent spirits; and both the tincture and infusion are found, by experiment, to be

be strongly impregnated with these two constituent principles of the bark. The tincture is, without doubt, an elegant and palatable medicine; but it is liable to this objection, which indeed holds equally true against spirituous tinctures in general, that a sufficient dose of the medicine cannot be given, on account of the heating nature of its vehicle. This preparation, however, might be rendered much stronger, if a larger proportion of bark, than is prescribed by the college of physicians, were to be employed.

EXPERIMENT XIII. Equal quantities, viz. six ounces by measure, of two tinctures of the bark, the one made after the *formula* of the London Dispensatory, the other with double the usual quantity of bark, were weighed with great exactness, in a nice pair of scales; and the latter was found to be eighteen grains heavier than the former, and to exceed in gravity the simple proof spirit thirty-seven grains. The stronger tincture had also a considerably deeper hue, and when mixed with water, became much more turbid.

IN nervous fevers, hysterical disorders, and other low cases, where it is necessary to join cordials to the bark, an infusion of it, in red port wine, may be prescribed with advantage. Under this form the famous empiric Talbot used to administer the *cortex*, in the paroxysms of intermittents; and so successful was his practice, that Louis XIV.

was

was induced to purchase, at a large price, the secret of his specific. Orange peel is an useful ingredient in preparations of the bark; it gives a grateful warmth to the infusion, and adds, I think, considerably to its efficacy. The following *formula* is agreeable to the taste, and well adapted to a weak and delicate stomach.

R. *Pulv. cort. peruv.* ʒj. *cort. aurant.* ʒfs. *aq. cinnamom. ten.* ℥j. *aq. cinnamom. sp.* ʒij. *m. et infunde, sine calore, per horas octo, vel duodecim, deinde filtra.*

THE use of trituration, in promoting the powers of solution, is evident, from Experiments IV. VI. and VII; and would have been still more so, if a proper apparatus had been employed. The Count de la Garaye, a French nobleman, who is distinguished for his assiduity in applying the different branches of philosophy to the improvement of medicine, hath described a very convenient machine, and pointed out an admirable process, for obtaining from vegetables, by triture with water, the matters in which their virtues chiefly reside. The contrivance is extremely simple, consisting only of a vessel to which a churning staff is fitted, which, by means of a cord and a wheel, is perpetually whirled with a rotatory motion. By this constant agitation, the most accurate diffusion is produced, and different portions of the *menstruum*
are

are, in quick succession, applied to every particle of the solvend.

FROM the fifth experiment no certain conclusions can be deduced; except that the extract is a much weaker preparation, than is commonly supposed. It is liable to all the objections which have been advanced against the decoction, with this additional one, that it is hardly possible to make it according to the process of the London Dispensatory, without giving it some degree of *empyreuma*. The extract, employed in my experiment, was prepared by a very diligent and careful apothecary, yet a considerable portion of it presently subsided, in a powdery form, to the bottom of the glass, which on examination appeared to be the burnt parts of the bark. How little then is this officinal medicine to be depended upon, when we consider the carelessness and inaccuracy of many of our druggists, and apothecaries (*k*).

IT

(*k*) It were to be wished, that the college of physicians would direct all extracts to be made, by means of a water bath. The following simple contrivance will fully, commodiously, and with very little trouble to the operator, answer this purpose. Let a pan be made of suitable dimensions, with a large circular hole in the cover of it, adapted to receive a china or glass basin, and with a curved pipe, two inches high, and half an inch in diameter, on one side: The cover should be closely cemented to the pan. Fill the vessel with a sufficient quantity

IT is the practice of the most eminent physicians to join acids with the bark, in the cure of putrid diseases; and Sir John Pringle hath observed, that in bilious fevers, the *cortex* answered best in Rhenish wine, after standing a night in infusion (*l*). This suggested to me the eighth experiment; and I flattered myself that, by macerating the bark in a mixture of vinegar and water, these two antiseptic medicines would be more accurately combined, and that perhaps the acid might promote the dissolvent power of the aqueous *menstruum*. In the latter expectation, it appears that I was disappointed; and whether the former was better founded must be left to abler judges to determine (*m*).

quantity of water; then place the basin in the cavity designed to receive it, and lute it well to the cover. The pan may now be set over a kitchen fire, and the liquor, intended for evaporation, poured into the china basin. From the closeness of the vessel, the heat which the water acquires, will exceed the common boiling point; and the evaporation will be proportionably expedited, without the least danger of producing an *emphyreuma*. The pipe will serve the double purpose of conveying a fresh supply of water into the pan, when it is wanted, and of carrying off some part of the steam. If a greater degree of heat be required, the pipe may be closed with a cork.

(*l*) Diseases of the Army, edit. 4, p. 213.

(*m*) Vide Experiments, XIX. XXVI.

THAT moderate heat promotes and assists the action of water, as a *menstruum*, on the bark, is evident from experiment the ninth; and it would be of advantage to determine, what degree of heat this drug will admit, without suffering a decomposition. It should however be remarked, that this infusion, though stronger, had neither so agreeable a flavour, nor was so sensibly impregnated with the *aroma* of the bark, as the two made with cold water.

IN an essay on the DISSOLVENT POWER OF QUICK LIME, a very ingenious chemist hath observed, that all resinous bodies become soluble in water, when the cohesion of their particles is destroyed, by withdrawing the fixed air which they contain. This method of solution he endeavours to apply to many valuable purposes in medicine; and hath described several useful and curious processes, for obtaining strong and elegant tinctures of the most active drugs by means of quick lime. The first part of the tenth experiment, *mutatis mutandis*, was borrowed from him; and it was hoped that an efficacious and palatable infusion might, with tolerable expedition, be made by the process, which he has laid down. But the success of my experiment was not answerable to the plausibility and ingenuity of the theory, which induced me to attempt it. The infusion, after standing twelve hours, the time pre-
scribed

scribed by Dr. Macbride, was but weakly impregnated with the bark: And when the maceration had been continued forty-eight hours, it by no means equalled, in strength, the preparation described, Exper. IV. It appears therefore, that quick lime, whatever its effect may be upon other medicines, neither quickens nor increases the solubility of bark in water: And it communicates to the infusion a taste, which is intolerably nauseous and disagreeable. That the chalybeate solution should produce no change, in the colour of these preparations, is agreeable to the laws of elective attraction. For the acid of the vitriol, having a stronger affinity with absorbent earths, than with metallic substances, forsakes the iron, with which it was combined, and unites itself to the quick lime. Hence arose the yellow, ochery sediment, taken notice of in the experiment. As the *residuum*, after filtration, did not effervesce with oil of vitriol, it is evident that quick lime is not endued with the power of abstracting, from bark, the fixed air which it contains.

EXPERIMENT XI. furnishes no other inference than this obvious one, that the decoction and infusion of the bark are calculated only for immediate use. The *cortex* is a substance of a very fermentable nature, as appears from the experiments of Dr. Macbride; and when its active parts are diffused in water, and separated from

such as are merely ligneous and inert, it is not to be wondered at, that it undergoes those changes, to which all vegetables, when favourably circumstanced, are liable.

As it is to be feared, that decoctions of the bark, from the facility with which they are prepared, will still continue in use, it may be necessary to suggest, that they should be poured upon the filter as soon as they are taken from the fire. Whilst the water is hot, the resinous part of the *cortex* will continue dissolved in it, and will readily pass through a coarse strainer; but if the *menstruum* be suffered to cool, it will separate, concrete together, and a considerable portion of it will remain in the filter: And thus the efficacy of the medicine will be greatly diminished.

S E C T I O N II.

IT appears from the preceding section, that the PERUVIAN BARK yields its virtues as perfectly to cold, as to boiling water; and that the simple infusion, in point of elegance and efficacy, is preferable to the decoction. But the latter preparation hath this advantage, that it is made with great expedition: For it is a fundamental

mental principle in chemistry, that heat quickens the action of almost every *menstruum*. To avail myself therefore of this assistance, without decomposing the bark, I made the following experiment, in the issue of which it will appear that I was disappointed.

EXPERIMENT XIV. A glass phial, lightly stopped, containing two drachms of powdered bark well incorporated with three ounces of spring water, was placed in a half-pint cup of cold water. The cup was set in a pan of boiling water, and kept in the boiling heat, for the space of an hour and a half. The phial was then taken out of the vessel, and the heat of it measured by Sir Isaac Newton's thermometer, when it was found to be about eight degrees below the boiling point, which is nearly equal to forty degrees in Fahrenheit's scale. The infusion whilst hot was clear, and of a deep red, but when cold it assumed a brown colour, and had a turbid appearance.

SEVERAL other experiments were tried, in order to determine what degree of heat the bark will bear, without decomposition; but I was unable to hit upon the precise point. And when I considered, that if it could be ascertained, few apothecaries in extemporaneous prescriptions would pay an exact attention to it, I dropt all further attempts towards the discovery of it. But the following experiment, which I have

made since the first edition of these essays, obviates the necessity of using heat, and points out a method of making, with sufficient ease and expedition, a saturated infusion of the bark.

EXPERIMENT XV. Two drachms of the *cortex*, finely powdered, were diligently triturated, fifteen minutes, in a marble mortar, with four ounces of rain water; and afterwards macerated without heat, three quarters of an hour. The infusion was then filtered through paper, and appeared, by all the tests used in the preceding experiments, to be considerably stronger than another preparation, which had been macerated twenty-four hours. Three ounces of it, by measure, weighed a grain and a half more than the infusion, prepared, according to the same proportions, without attrition.

A SIMILAR preparation was made by triturating the *cortex* ten minutes only, and then filtering without digestion. But the *menstruum* was by this method less impregnated with the bark, as its taste, colour, specific gravity, and the diminished effect of the chalybeate solution, clearly evinced. The elegance and strength of this preparation are increased, by the addition of a small quantity of French brandy, during the triture.

EXPERIMENT XVI. It is evident from the seventh experiment, that a considerable quantity of the resin of the bark is soluble in cold water; but

but I was desirous of trying, whether the whole of it might not be dissolved, by repeated affusions of the same *menstruum*. For this purpose I macerated half an ounce of powdered bark, for the space of three days, in six ounces of spring water: The *menstruum* was then decanted off, and fresh water added in the same quantity as before. This affusion was repeated at equal intervals thirty times, till the water was insipid, colourless, and unalterable by the addition of green vitriol. The *residuum* also, when chewed in the mouth, had no sensible bitterness or astringency. Two drachms of this *residuum*, carefully dried by a very gentle heat, were infused in an ounce of rectified spirit of wine; and in two days, a tincture was produced of an orange colour, and bitter taste.

EXPERIMENT XVII. Half an ounce of powdered bark, loosely tied up in a linen rag, was boiled over a quick fire twenty-five times, in so many different pints of spring water. Each coction was continued twenty minutes, and repeated till the *menstruum* received no sensible impregnation from the bark. After the twenty-fifth boiling, it was perfectly tasteless, struck no black with *sal martis*, and the powder, when chewed in the mouth, was equally insipid with the liquor. Two drachms of the *residuum*, cautiously dried, were digested forty-eight hours, in an ounce of *sp. vin. rectificat.* The spirits acquired a deeper colour,

and were more strongly impregnated with the bitterness of the *cortex*, than in the preceding experiment. But neither this nor the former tincture struck a black with green vitriol, owing probably to the insolubility of that metallic salt in rectified spirit of wine.

EXPERIMENT XVIII. A drachm of powdered bark was digested, without heat, forty-eight hours, in two ounces of rectified spirit of wine. The clear tincture was then poured off, and fresh spirit, in the same quantity as before, was added to the *residuum*. The digestion was thus repeated six times, until the *menstruum* acquired neither taste nor colour from the bark. The powder was then carefully dried, and afterwards successively macerated without heat, in two several portions of spring water; to each of which it communicated the property of striking a purple colour with green vitriol. Both these infusions were insipid; so that rectified spirit seems to have the power of extracting all the bitterness of the *cortex*, though not all its astringency. Is not this fact repugnant to what Dr. Lewis hath observed of this drug, “that its astringency resides wholly in its resin, which does not appear to be in any degree soluble in watery liquors?” (*n*) The same ingenious writer is likewise mistaken, when he asserts that

(*n*) Neumann's Chem. by Lewis, p. 339, note (*x*).

the resin of the bark melts out in the first boilings, and that the subsequent decoctions are transparent and bitter, without the least turbidness or astringency (*o*). For in making the seventeenth experiment, I found the decoction, after the twentieth boiling, struck a purple colour with *sal martis*. The three last trials furnish a clear proof of the slow and difficult solubility of the bark. Fuller says, with some degree of admiration, *Cum olim experimenti causa ejusdem (corticis) pulverem sæpius decoxissem, non eo usque vires ejus exhaurire valui, quin vel octavum decoctum adhuc amaricaret* (*p*). If his patience had permitted him to extend his experiment, what would have been his surprize to find, that even twenty-five coctions, and thirty cold macerations, are insufficient to exhaust the virtues of the *cinchona*! An ingenious friend of mine informs me, that he reduced the bark, by extraction and decoction, to an insipid powder, which was given in the dose of two drachms to a patient labouring under a quotidian fever, an hour or two before the accession of the paroxysm. It mitigated the fits by degrees, changed the quotidian into a tertian, and then entirely removed it.

EXPERIMENT XIX. To determine, with more accuracy, the relation which different

(*o*) Ibid.

(*p*) Fuller. Pharm. Extemp. p. 5.

menstrua bear to the bark, I digested a drachm of the *cortex* weighed with great exactness, in equal quantities, viz. three ounces, of each of the following liquors. 1. Spirit of wine rectified. 2. French brandy. 3. Rhenish wine. 4. Cold water. 5. Cold water, with the addition of a drachm and a half of white wine vinegar. After seven days infusion, the clear part of each *menstruum* was carefully poured off, and the *residuum* evaporated to dryness. The weight, which the bark lost by digestion, is expressed in the following table, which shews the comparative powers of solution of the several liquors, mentioned above.

Cort. Peruv. ʒj. infused seven days in

		Grains.
<i>Sp. vin. rectificat.</i>	lost	6
<i>Sp. vin. gallic.</i>	—	$8\frac{1}{4}$
Rhenish wine	—	9
Water	—	8
Water and vinegar	—	8

RHENISH wine, from this experiment, appears to be the most active *menstruum* for the bark. Whether it owes any part of its superior solvent power to the acid, with which it is replete, cannot with certainty be determined; but I am inclined to think it doth not, because the solution of the *cortex* is not in the least promoted, by the addition
of

of vinegar to water. Dr. Lewis says, that proof spirit extracts less from bark than rectified spirit(*q*); but from the preceding trial, which was made with all possible exactness, it is evident he is mistaken. This experiment likewise affords the most satisfactory proof, that cold water is a powerful *menstruum* for the *cinchona*. It is considerably more active than rectified spirit of wine, and is very little inferior to brandy. Perhaps the *residuum* of the watery infusion would have weighed less, if the maceration had been continued only two days: For water, after extracting from bark all that it is capable of dissolving, precipitates some part of it again.

EXPERIMENT XX. Two drachms of gentian root were macerated forty-eight hours, in three ounces of cold spring water: The same quantity was boiled over a quick fire, in four ounces of water, till a fourth part was consumed. The infusion had a more intensely bitter, and at the same time a much less disagreeable taste than the decoction, which was mucilaginous, and highly nauseous. Six grains of *sal martis* were added to each; but neither of them changed colour. The same experiment was repeated with Aleppo galls. The decoction manifested more roughness and astringency to the taste, than

the infusion, but did not strike so black a colour with green vitriol. Dr. Lewis informs us, that by steeping the *carduus benedictus* for a few hours in cold water, a very agreeable bitter is procured; but if heat be employed, the more ungrateful parts of the plant are taken up, and the infusion becomes so nauseous, as to provoke vomiting. If fena be infused in cold or, for a little time, in warm water, the liquor will purge far more mildly, than an infusion made in hot water for a longer time, though both infusions be reduced to the same degree of strength, by a suitable evaporation(*r*). Camomile flowers, as I have long experienced, have their bitterness very perfectly extracted by cold maceration; and in this way they are much more grateful, than when infused in boiling water. An ounce of flowers, and half an ounce of orange peel, macerated in three pints of water, for twenty-four hours, make a light, cheap, and agreeable stomachic medicine. Green and bohea tea yield a finer flavour to a cold than hot infusion, and they strike as deep a black by the former, as by the latter method of preparation. Oak bark, it is well known, is always steeped in cold water, for the purpose of tanning: And I suppose the artists, in that branch of trade, find that the

(*r*) Vide Neumann's Chem. p. 267.

application of heat is not necessary to extract its astringency. May we not therefore justly conclude, from the preceding experiments and observations, that cold water is a more universal and powerful *menstruum*, than hath hitherto been apprehended; and that its use in pharmacy is at present too much neglected.

THE result of the eighth experiment was so contrary to my expectations, that I determined to make further trials of the effects of acids, in destroying that property in certain vegetable substances, by which they strike a black colour with chalybeates, which hath been long regarded as an indubitable test of astringency.

EXPERIMENT XXI. An ounce of the infusion of camomile flowers was divided into two equal portions; to one was added a drachm of white wine vinegar, to the other an equal quantity of spring water. Thus, with respect to dilution, they were precisely in the same circumstances. A tea spoonful of the solution of *sal martis* was then mixed with each of them. The portion, which contained the vinegar, suffered no change of colour; the other instantly assumed a dusky hue. The same experiment was repeated, with a very strong triturated infusion of the bark, and the result was nearly the same. As soon as a drachm of the vinegar was added to half an ounce of the infusion, it changed the colour of it, from a deep

deep and reddish brown to a bright yellow; whilst the same quantity of water had no sensible diluting effect on the other portion, with which it was mixed. The chalybeate solution, as in the former experiment, was then added. It produced no alteration in the portion with vinegar, but the other it changed into a perfect ink.

EXPERIMENT XXII. To half an ounce of a strong infusion of galls, were added two drachms of the solution of *sal martis*. It presently assumed the appearance of ink. Forty drops of the acid of vitriol restored it to its original colour. Thirty drops of the *sp. c. c. vol.* renewed the inky blackness.

IN these experiments, it is obvious that an affinity subsists between acids, astringents, and bitters; and this suggested to me that they may possibly neutralize each other, and when combined together in due proportion, form what the chemists term a *tertium quid*. This important point, from which many useful inferences may be deduced, I attempted to ascertain in the following manner.

EXPERIMENT XXIII. To half an ounce of a light infusion of the bark, I added twenty drops of white wine vinegar. The acid and the bitter entirely corrected each other, and a new taste was induced: After standing twelve hours, the
mixture

mixture changed from a light yellow to a deep chocolate, and deposited a large brown sediment.

EXPERIMENT XXIV. The same quantity of vinegar was added to half an ounce of an infusion of Aleppo galls. The mixture was more austere and astringent to the taste, than the infusion. After standing twelve hours, it deposited a flocculent, whitish sediment, and the liquor above became less austere to the taste, than the simple infusion itself.

EXPERIMENT XXV. To equal quantities of spring water, and of a strong infusion of gentian root, in separate glasses, was added one drachm of white wine vinegar. The acid was entirely covered by the infusion, but the spring water was manifestly sour to the taste. Sixty drops of the syrup of violets were then added to each. The infusion suffered no change of colour; but the water assumed a light red, inclining somewhat to purple. Imagining that the deep colour of the infusion prevented me from perceiving the action of the acid on the vegetable blue, I took the same quantity of old mountain wine, which was precisely of the colour of the infusion of gentian, and adding to it a drachm of vinegar, and sixty drops of syrup of violets, I found a slight purple redness manifest itself, about an hour after the mixture. The same experiment was repeated, with a strong infusion of galls and distilled

distilled vinegar; but the result was not so obvious as in the former one, probably on account of the weaker powers of the acid employed.

EXPERIMENT XXVI. Sir John Pringie hath proved, that neutral salts resist putrefaction with considerably less force, than the acids and alkalis of which they are composed. *Spiritus mindereri*, for instance, is not half so antiseptic as the *sal. c. c. vol*: And the common saline mixture of *sal. absinth.* and *succ. limon.* is only three fourths as antiputrescent, as salt of wormwood separately taken (*s*). Dr. Macbride also hath shewn, that acids and alkalis have the power of restoring sweetness to putrid substances, but that, when mixed together to the point of saturation, they lose this property (*t*). As there seems therefore, by the three foregoing experiments, to be an analogy between the combination of acids, astringents, or bitters, and acids and alkalis, curiosity induced me to pursue it; and I flattered myself that, though my attempts should prove unsuccessful, some useful facts might offer themselves to my notice, and that my labour would not be without reward.

AN ounce and a half of mutton, chopped very small, was divided into five equal parts, and put

(*s*) Diseases of the Army, Append. Exp. v. 1x.

(*t*) Macbride's Essays, p. 129.

into so many different phials. To the first, which was designed for a standard, were added twelve drachms of spring water; to the second, ten drachms of water, and two drachms of white wine vinegar; to the third, ten drachms of the decoction of the bark, and two drachms of vinegar; to the fourth, ten drachms of the decoction of the bark; to the fifth, ten drachms of water, and one scruple of bark finely powdered. The bottles were lightly stopped, and set in a sand bath, the heat of which was regulated by a thermometer, and kept up to the hundredth degree of Fahrenheit's scale. In the night, the lamp was suffered to go out. The changes, as they occurred in the mixtures, were carefully noted down, and were as follows:

THE standard phial, in seven hours, emitted many air bubbles, and was frothy at top; but had acquired no fetor; No. 4. the decoction of the bark, was also a little frothy. The next day the standard smelled offensively, and No. 4. was just perceptibly tainted. The third day, the standard was very fetid; No. 4. was evidently putrid. The fourth day, the standard was so extremely offensive, that I removed it. No. 2. the vinegar and water, was not quite sweet. No. 3. the decoction of the bark and vinegar, was unchanged. No. 4. the decoction of the bark, was very fetid. No. 5. the powder of bark and

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water, was quite sweet, but a little mouldy. The fifth day, No. 2. the vinegar and water, was more offensive than before. No. 4. the decoction of bark, was so putrid that I removed it. No. 3. and 5. were quite sweet.

THE sixth day. The phials were removed from the sand bath yesterday, on account of an accident which happened to the lamp; and they remained in the cold for twenty hours. This morning, they were set by a warm fire. They were not much changed, since the last examination.

THE seventh day. No. 2. the vinegar and water, was very offensive, but had a peculiar fetor, totally different from the putrid smell of No. 1. and No. 4. It was therefore removed. No. 3. and No. 5. were sweet.

THE eighth day. No. 3. the decoction of bark and vinegar, was a little tainted. No. 5. the powder of bark and water, was perfectly sweet, and did not become sensibly putrid, till the thirteenth day from the time of mixture.

EXPERIMENT XXVII. To an ounce of putrid ox-gall, were added, an ounce and a half of the decoction of bark, one drachm of the powder of bark, and three drachms of white wine vinegar. The putrid smell of the gall was entirely corrected; and the mixture continued sweet fourteen days, though it was placed near a warm fire.

IN the event of the two last experiments, I was very much deceived. Before I undertook them, I was almost fully persuaded, that there subsisted a complete analogy between the combination of acids and astringents or bitters, and acids and alkalis; and that the neutrals, formed by the mixture of the former, like those of the latter, would prove less antiseptic than the substances, separately taken, of which they are composed. This preconceived hypothesis led me to suspect the present practice of joining acids and the bark, in the cure of putrid diseases, to be very improper, as I imagined they would counteract each other's effect. To ascertain this important point, I made the two preceding experiments, with the most minute exactness; and though the result of them was the very reverse of what I had supposed, I was neither mortified with my disappointment, at that time, nor am I now ashamed to acknowledge it. In a long course of experiments, which are undertaken with some particular view, and not made at random, instances of self-deception frequently and unavoidably occur; and in general they happily serve as a spur to industry. We first conceive a fact, and then set about the demonstration of it. If the trial succeed, our end is obtained, and for the most part we rest satisfied. But if the proof fail, some unexpected phænomena oftentimes occur, which awaken our attention, and excite us

to new pursuits. But whether this be the case or not, success or disappointment are equally useful, in experimental inquiries; because a negative truth may be of as much importance as a positive one.

THE five last experiments furnish, at least, a presumptive proof, that acids and astringents or bitters, neutralize each other. By mixture, it appears their taste and smell are altered; the acids lose their property of striking a red colour with syrup of violets; and their antiseptic powers, in combination, are double the sum of them, when separately employed. The bark likewise, with vinegar, [Exper. XXVII.] hath the power of restoring sweetness to putrid substances, which it hath not alone, as Dr. Macbride affirms(*t*). Sir John Pringle hath indeed asserted the contrary; but, in his experiment, the putrid alkali seems to have been washed off, not corrected, by repeated affusions of the decoction of the bark.

EXPERIMENT XXVIII. Four pieces of calfskin, fresh stripped from the calf, and exactly equal in size, were immersed, one in an ounce and a half of the infusion of bark; the second in an ounce and a half of the same infusion, with two drachms of white wine vinegar; the third in an ounce and a half of the infusion of Aleppo galls; the fourth in

(*t*) Macbride's Experimental Essays, p. 130.

an ounce and a half of the infusion of galls, with two drachms of vinegar. At the end of seven days, they were taken out, and carefully examined. The pieces, which had been immersed in the infusions of galls, and bark with vinegar, were much softer and more swollen, especially in the middle, than the other two pieces: And the cuticle very easily separated from the cutis, which was not the case with the others. So that the acid seemed greatly to diminish the astringent powers of these two infusions. The pieces were all so shriveled, that I could not easily measure them, nor determine which was the most contracted in size.

VINEGAR, it is well known, hath the property of softening animal fibres, in a very remarkable degree; and, diluted with warm water, it is frequently employed as a resolvent, in external topical inflammations. But, when taken internally, or applied to any very sensible membrane, it acts as an astringent. Thus in the mouth, it corrugates the tongue and palate, and induces a paleness in the lips, by contracting the small capillary arteries, which run upon their surface. And when injected into the *vagina*, it proves an excellent remedy in the *fluor albus*, but requires, in some cases, to be diluted with water, otherwise it would be too suddenly astringent and corroborant. On what principles it produces such opposite effects

on the dead and living fibre, would be difficult with certainty to determine. Perhaps its astringent property may depend upon its stimulus, which can only exert itself on the *solida viva*; as the simple solids are the proper subjects of its resolvent power. But although the preceding experiments clearly prove, that vinegar, in combination with astringents, diminishes their corrugating effects on the dead fibre; I would by no means infer that its action is the same, when applied to the living fibre, or that acids and the bark are improperly exhibited together, in the cure of hemorrhages. From the twenty-fourth experiment it appears, that the infusion of galls is rendered much more austere to the taste, by the addition of vinegar; and it is not improbable that its astringent power, as a medicine, is increased in the same proportion. For I apprehend that the taste, with respect to the operation of this class of vegetables on the body, is the least fallacious test of astringency. I term it the least fallacious test, because it will be shewn afterwards, in the succeeding section, that neither the taste, nor the property of striking a black colour with chalybeates, nor yet the power of hardening animal fibres, whether separately or collectively taken, are certain criteria of the astringent power of a medicine on the living body (*u*).

I SHALL

(*u*) WHEN the twenty-eighth experiment was made, it did not occur to me to try the effects of the mineral acids,

I SHALL conclude this section with a few obvious practical inferences, from the foregoing observations and experiments.

1. IT is the opinion of a very eminent physician, that the bark, when taken in substance, disagrees with weak stomachs, on account of its fermenting quality(*x*). But I think the sixteenth, seventeenth, and eighteenth experiments, which prove its remarkably slow solubility, furnish a better explanation of the fact. When the stomach is overloaded with a dose of the *cortex*, in powder, a sense of weight and oppression, not of flatulency or distension, is for the most part complained of. And it is a common, and I believe useful practice, to join aromatics with the bark, and that doubtless with a view to stimulate the digestive powers, and quicken its passage through the *primæ viæ*. For as it is evident, from the experiments of Sir John Pringle himself, that they are of a very fermentable nature, they cannot correct, but must rather promote that tendency in the *cortex*, and add to the uneasiness which it occasions, by the fresh generation of air. But the

acids, in conjunction with the vegetable astringents. But I have since found, by an experiment made with the decoction of the bark and elixir of vitriol, that the astringent power of the former is much increased by the addition of the latter.

(*x*) Pringle's Dis. Army. Append. p. 66.

best proof that the bark is not so prone to run into fermentation, and that it is in some stomachs almost indigestible, is the case of a patient of the late Dr. Alston, who vomited up a dose of it almost unchanged, eight days after taking it(y). A very ingenious friend of mine hath remarked, in the course of his practice, that the bark, in substance, is less oppressive, when given in draughts, than either in the form of a bolus or electuary. A considerable quantity of unfixed air, he says, adheres to the particles of the powder, which occasions disturbance, when carried into the stomach. By combining the *cortex* with any liquid, this air is in a great measure, he thinks, separated, as appears by the bubbles which are formed, and the frothyness which is produced, during the act of mixture.

THE fact is curious, and I doubt not, accurately stated; but the explanation of it is more plausible than satisfactory. The bark, when administered in draughts, is generally mixed with some agreeable aromatic water, which renders it more palatable, dilutes it in the stomach, and by its grateful warmth, promotes the more speedy digestion of it. But when given in a bolus or electuary, which are for the most part made up with syrups, it is

(y) Cullen's Lect. on the Mat. Medica.

peculiarly

peculiarly nauseous, owing probably to the unpleasant combination of sweet and bitter. And it is a common observation, that what is disgusting to the palate is generally offensive to the stomach. The more solid form of these two preparations is likewise unfavourable to quick solution. Soap pills have been known to pass undissolved through the whole intestinal canal. In a weak state therefore of the stomach and bowels, we need not wonder that a large mass of an electuary of the bark should lie long unchanged, and prove very oppressive.

2. As it appears, from several experiments, that bitters have the property of neutralizing acids, their use, in acidities of the first passages, is very obvious. In such cases indeed, they may be considered as indicated on a double account, to correct the disease when present, and by their bracing and corroborant effects, to remove the cause, and prevent the return of it. When given with such intentions, they should be infused in brandy, or in some of the stronger wines. It has been long the practice to exhibit bitters, in icterical complaints, as a substitute for the bile. But though with this view they are improperly employed, as being antiseptic, retarders, and moderators of fermentation, and consequently

frequently very different from the bile, which is possessed of all the opposite qualities ; yet I cannot join with a very celebrated physician, in opinion, that they do little or no service in the jaundice(z). This disease, when it has been of some standing, is almost always accompanied with loss of appetite and indigestion, and with acidities and flatulencies in the *primæ viæ*. The stomach and bowels, from the defect of bile, are deprived of their usual *stimulus*, their peristaltic motion is impaired, and the food, by long stagnation, runs with violence through its successive stages of fermentation. In this state of the distemper, the *saliva* and *succus pancreaticus* probably acquire a morbid disposition, and instead of assisting digestion, and checking the generation of air, serve rather to injure the one, and promote the other, increasing the general tendency to sourness and crudity. Under these circumstances, evacuants, antacids, and antifermentatives are certainly indicated. Vomits and purgatives answer the first, and bitters the two last intentions. The former are adapted to remove the cause of the disease ; the latter only to palliate some of its most troublesome symptoms. In this view

(z) Pringle's Append. to Dis. Army, p. 72.

however they are of importance; and the use of them should by no means be discouraged.

3. IN a posthumous work of the learned Dr. Boerhaave, published by his pupil Van Eems, it is asserted, that the deleterious effects of scammony, colocynth, and spurge, are corrected by vinegar (*a*). These are all vegetable bitters, and probably the action of the acid consists in neutralizing them. If this be the case, the use of vinegar, as an antidote, may perhaps be more extensive than is commonly supposed. For many of those substances, which on account of their virulent and pernicious effects on the body, are termed poisons, have a considerable degree of bitterness; as may be instanced in the *lauro-cerasus*, *nux vomica*, *belleborus*, *nicotiana*, *camphor*, *opium*, *euphorbium*, *asarum*, *bryonia*, *colocynthida*, *elaterium*, *chelidonium majus*, &c. And it is at least as probable that their noxious qualities reside in their bitter, as in any other part of their composition (*b*).

4. DR.

(*a*) Boerhaave de Morb. Nor. Cap. de Paralyfi.

(*b*) ON communicating this conjecture to my ingenious and learned friend Dr. Dobson of Liverpool, he furnished me with the two following experiments in confirmation of it.

4. DR. HILLARY, in his treatise on the Yellow Fever of the West India islands, discommends

EXPERIMENT I. " May 21, 1764. Twelve grains of opium, dissolved in half an ounce of water, were given to a pointer bitch, that weighed twenty-five pounds and two ounces. The natural state of her pulse was from 110 to 115 pulsations in a minute; and it should be premised, that in making the following experiments, I never examined the pulse, but after she had been in my room 15 or 20 minutes, and was either asleep, or lay at rest.

SOON after giving her the opium, she looked heavy; flavered a great deal; and appeared to be much offended with the taste of the opium.

WHEN at liberty, she went out into the open air, but was dull and moved slowly.

ONE HOUR AFTER; pulse 75. Very uneasy and distressed. An universal rigor and trembling every five or six seconds.

TWO HOURS AFTER; pulse 60. Had run out into the street for half an hour; head rather giddy, with an unsteadiness in her gait; complains and groans frequently; heavy, but does not sleep much; flavers a great deal.

THREE HOURS AFTER; pulse 59. In other respects much the same.

FIVE HOURS AFTER; pulse 60. Had been in the open air for more than an hour; rather staggered as she went down some steps; frequently kept her head very erect, but not steady; slept very little; lost all her playfulness; flavers; refuses to eat bread; offended with the taste of the opium; and has still the tremblings and twitchings.

EIGHT HOURS AFTER; pulse 80. More brisk, and seems to be coming to herself again.

TWELVE

commends the use of the bark in that disease, chiefly on account of its disagreement with the

TWELVE HOURS AFTER ; pulse 86. Had followed the servant for more than a mile ; still more herself.

SIXTEEN HOURS AFTER ; pulse 113. Not much different from her usual appearance.

EXPERIMENT II. May 28, 1764. Twelve grains of opium, dissolved as in the former experiment, and with the addition of 30 drops of the acid elixir of vitriol, were given to the same pointer. Much offended with the taste ; foams and flavors.

ONE HOUR AFTER ; pulse 90. Slavers very little ; alert as usual. As she lay asleep in my room, she had a little rigor and trembling.

TWO HOURS AFTER ; pulse 85. There were now given her 20 drops of the elixir of vitriol, in an ounce of water ; flavored a little after this.

THREE HOURS AFTER ; pulse 80. The flavering soon ceased ; is not near so much offended with the taste of the opium, as in the former experiment. Rigor and trembling very observable, but only when asleep : 30 drops of elixir of vitriol were now given ; and one hour after this, 20 drops more ; so that she has had, in all, 100 drops of the elixir of vitriol, within the four hours.

FIVE HOURS AFTER ; pulse 95. Brisk ; some of the twitchings, but only when asleep.

EIGHT HOURS AFTER ; pulse 120. Not much different from her usual appearance ; some very slight twitchings, as she lay asleep.

THESE and some other experiments were made, in order to ascertain the efficacy of acids in counteracting the deleterious qualities of opium. When an over dose of opium has remained in the stomach for some time, the sensibility of

the stomachs of his patients. He acknowledges however, that it is strongly indicated, and seems to lament that, even under the pleasanter form, it cannot be retained. But from the twenty-seventh experiment I should conclude, that it would sit tolerably easy, or at least that it would not be rejected, if it were combined with the vegetable acids. A redundance and corruption of the bile are the pathognomonic symptoms of this fever; and notwithstanding the incredible evacuation of it, in the first stage of the distemper, there still continues, through the whole course of it, both an inordinate secretion of that humour in the liver, and a depravation of it in the first passages. In such circumstances, the bark, given by itself, cannot fail to disagree; for when mixed with putrid gall, it is observed greatly to increase the fetor of it (*c*).

of that organ is almost entirely destroyed, so that the most active emetics are ineffectual to evacuate the poison. It is a matter of consequence therefore, in this case, to know what class of medicines we may next have recourse to, with the greatest probability of success. As the opium cannot be rejected from the stomach, relief is only to be expected from such remedies, as will change the nature of the opium itself: And how far this end is to be attained, by the liberal use of acids, the reader may judge by comparing these two experiments."

(*c*) Macbride's Essays, p. 140.

But

But when joined with acids, which have the power of neutralizing the corrupted bile, as will hereafter be proved, it can occasion no disturbance, and must be highly serviceable, not only as an antiseptic, but also as a corroborant. The truth of this remark is confirmed, even by the practice of Dr. Hillary himself, who exhibits an infusion of snake-root, as a substitute for the *cortex*, and accompanies it with the elixir of vitriol.

S E C T I O N III.

HAVING frequently observed, during the course of my experiments, that the astringency and bitterness of vegetables are distinct and separate properties, I was desirous of tracing their differences, and of ascertaining the proportion, which they reciprocally bear to each other. To this end, I made a variety of trials, and though not with all the success that I wished or expected, yet as they throw some light on this intricate subject, I shall here faithfully relate such of them, as were most conclusive and satisfactory.

EXPERIMENT XXIX. To equal quantities of strong infusions of Aleppo galls and gentian
root,

root, were added two drachms of a solution of green vitriol. The infusion of galls instantly struck a deep inky blackness: That of the gentian root was unaltered in colour. The former, it is well known, is very slightly, the latter very intensely bitter.

EXPERIMENT XXX. To equal quantities of strong infusions of rue, wormwood, gentian, green tea, bohea tea, bistort, and galls, was added a teaspoonful of the solution of *sal martis*. The galls assumed the deepest black; the infusion of bistort was next in degree; then followed the green and bohea tea, between which I could perceive no difference; the tinge of the wormwood and rue was a little deepened, but the gentian was unaltered. Their degrees of bitterness were in the following order; 1. gentian. 2. wormwood. 3. rue. 4. green and bohea tea. 5. bistort. 6. galls. The two last were very slightly bitter. Twenty drops of white wine vinegar discharged the colour, induced by the green vitriol on the infusions of rue and wormwood: A hundred drops considerably diminished the blackness of the infusions of galls, bistort, and bohea tea. But the first, after standing twenty-four hours, recovered its inky colour, and a number of fine jet-black flakes floated about in it, without subsiding: The colouring particles of the two last, much diminished in their blackness, sunk to the bottom of the

the glasses. Twenty drops of oil of vitriol entirely discharged the black colour of the green tea, and it continued clear and pellucid.

EXPERIMENT XXXI. To determine the comparative antiseptic powers of bitters and astringents, I put into ten phials marked 1, 2, 3, &c. a drachm and a half of mutton, which had been kept several days, but was perfectly sweet. To the first, which was intended for a standard, was added an ounce of spring water; to the second, an ounce of a cold infusion of green tea; to the third, an ounce of an infusion of common wormwood; to the fourth, an ounce of the decoction of the bark; to the fifth, an ounce of the infusion of galls; to the sixth, an ounce of a cold infusion of the bark; to the seventh, an ounce of a cold infusion of rue; to the eighth, an ounce of a cold infusion of bistort; to the ninth, an ounce of a cold infusion of bohea tea; to the tenth, an ounce of a cold infusion of gentian. By mistake, only the five first phials were placed in the sand bath, the other five were left in my study window, which has a northern aspect. I was called from home, and was absent three days and a half. On my return, I found No. 1, 2, 3, 4, the standard, the green tea, the wormwood, and the decoction of bark, were all putrid, but in different degrees, according to the order in which they are marked down. No. 5. the infusion of galls was unchanged. The

VOL. I. G mixtures,

mixtures, which had been left in my study window, were quite sweet; but they seemed to have some little fermentative motion in them. They were placed in the sand bath, and the next day, I examined them. No. 7. the infusion of rue was very offensive. No. 6. the infusion of bark was putrid, but in a less degree than the rue. No. 5. 8. 9. 10. were all sweet. The day following, No. 9. the infusion of bohea tea, was very putrid. No. 8. the infusion of bistort, was a little tainted. No. 5. the infusion of galls, and No. 10. the infusion of gentian, continued sweet; and as they remained unchanged several days longer, I removed them from the sand bath, fully satisfied with the proof of their strong antiseptic powers.

EXPERIMENT XXXII. Eight pieces of calf skin, just stripped from the calf, and exactly of equal sizes, viz. two inches long and an inch broad, were severally immersed in an ounce and a half of each of the following preparations.

1. *Decoct. cort. peruv.* 2. Cold infusion of the bark.
3. Cold infusion of galls. 4. Cold infusion of gentian.
5. Cold infusion of green tea. 6. Cold infusion of bohea tea.
7. Cold infusion of rue.
8. Simple water, as a standard.

At the expiration of a week, they were taken out and examined. The piece in the water, was soft and putrid. That in the infusion of rue, was sweet, but soft. Those in the infusions of green and bohea tea,

were

were hard and curled up; nor did there appear to be any sensible difference between them. The infusion of gentian seemed to possess no inconsiderable degree of astringency; for the piece of skin immersed in it, was nearly as hard, and as much shrivelled, as those in the infusions of green and bohea tea. The decoction and infusion of the bark were, to all appearance, alike in their degree of astringency, which was rather greater than that of tea, but much inferior to the galls.

THIS experiment affords a striking proof, of the difference between the action of a medicine on the dead, and on the living fibre. Tea, when applied to the former, is manifestly astringent; and yet, when received into the stomach, it is highly debilitating and relaxant, and the immoderate use of it, is attended with the most pernicious effects. It is curious to observe the revolution, which hath taken place within this century, in the constitutions of the inhabitants of Europe. Inflammatory diseases more rarely occur, and, in general, are much less rapid and violent in their progress, than formerly (*d*). Nor do they admit of the same antiphlogistic method of cure, which
was

(*d*) THE decrease in the violence of inflammatory diseases may, perhaps in part, be ascribed to the present improved method of treating them. Moderate evacuations, cool air, acescent diet, and the liberal use of saline

was practised, with success, a hundred years ago. The experienced Sydenham makes forty ounces of blood the mean quantity to be drawn, in the acute rheumatism; whereas this disease, as it now appears in the London hospitals, will not bear above half that evacuation. Vernal intermittents are frequently cured by a vomit and the bark, without venæsection; which is a proof that, at present, they are accompanied with fewer symptoms of inflammation, than they were wont to be. This advantageous change however is more than counterbalanced, by the introduction of a numerous class of nervous ailments, in a great measure unknown to our ancestors, but which now prevail universally, and are complicated with almost every other distemper. The bodies of men are enfeebled and enervated, and it is not uncommon to observe very high degrees of irritability, under the external appearance of great strength and robustness. The hypochondria, palsies, cachexies, dropsies, and all those diseases, which arise from laxity and debility, are in our days endemic every where; and hysterical affections, which used to be peculiar to the women, as the term indicates, now attack both sexes almost indiscriminately. It is evident, that

and antimonial medicines, are better adapted to check the progress of fevers, than copious bleedings, stimulating purgatives, and profuse sweats, excited by *theriac* or mithridate.

ſo great a revolution could not be effected, without the concurrence of many cauſes; but amongſt theſe, I apprehend, the preſent general uſe of tea holds the firſt and principal rank. The ſecond place may perhaps be allotted to exceſs in ſpirituſous liquors. This pernicious cuſtom, in many inſtances at leaſt, owes its riſe to the former, which by the lowneſs and depreſſion of ſpirits it occasions, renders it almoſt neceſſary to have re-ſource to what is cordial and exhilerating. And hence proceed thoſe odious and diſgraceful habits of intemperance, with which too many of the ſofter ſex, of every degree, are now, alas! chargeable.

FROM the twenty-ſeventh and twenty-ninth experiments, it appears, that green and bohea tea are equally bitter, ſtrike precisely the ſame black tinge with green vitriol, and are alike aſtringent on the ſimple fibre. From this exact ſimilarity in ſo many circumſtances, one ſhould be led to ſuppoſe, that there would be no ſenſible diverſity in their operation on the living body. But the fact is otherwiſe. Green tea is much more ſedative and relaxant than bohea; and the finer the ſpecies of tea, the more debilitating and pernicious are its effects, as I have frequently obſerved in others, and experienced in myſelf (*e*).

This

(*e*) I HAVE now under my care a lady, of a moſt delicate conſtitution, who has been long ſubject to a

This seems to be a proof that the mischiefs, ascribed to this oriental vegetable, do not arise from the warm vehicle, by which it is conveyed into the stomach, but chiefly from its own peculiar qualities (*f*). And these qualities probably accompany the highly flavoured parts of the leaves, and depend upon the nicety and care observed in the collection and preparation of them. When fresh gathered, they are said to be narcotic, and to disorder the senses; and the Chinese cautiously abstain from the use of them, till they have been kept for twelve months (*g*).

It

profluvium mensum, to frequent diarrhæas, and to copious and sudden discharges of urine. Bohea tea, of a moderate degree of strength, seldom fails to check the *catamenia*, and she has used it for this purpose ten or twelve months. Green tea, whenever she drinks it, produces tremors, anxiety, and a large flux of urine, which she voids in the quantity of two or three pints at once. The bladder is not over distended, previous to the discharge; but she feels, (to use her own expression) as if the urine flowed from all parts of her body to the kidneys, during the time of micturition. It should be remarked, that this lady never uses bohea tea, but at a particular period, medicinally.

(*f*) *THEÆ* infusum, nervo musculove ranæ admotum, vires motrices minuit, perdit. Smith, *Tentamen Inaug. de actione musculari*, p. 46, exp. 36.

(*g*) Neumann's *Chemistry*, p. 376.

A GENTLEMAN of veracity, who commanded an East India

It is remarkable that only one species of the tea plant is yet discovered, and that all the varieties of this dietetic article of commerce, are owing either to the difference of climate, or to the diversity in the method of curing it. The fine green teas, which are the first crop of the shrub, are gathered with the utmost caution, and dried with the gentlest heat, that their perishable flavour may be preserved. The bohea teas are more hastily exsiccated, and even slightly parched over the fire, by which they acquire that brown colour which distinguishes them. And as their more volatile parts are dissipated by this management, they become proportionably less injurious to the nervous system.

An ingenious physician, who has done me the honour to adopt my sentiments, and to quote my arguments against the use of tea, in his Inaugural Dissertation, published at Leyden, 1769, has confirmed my testimony, by the following experiments (*b*). “ He injected into the cavity of the
abdomen,

India ship several voyages to China, says that the Chinese rarely drink the green tea; and that those, who drink it to excess, are thrown thereby into a diabetes, or become tabid, and die emaciated.

Vid. Med. Museum, vol. II. p. 51.

(*b*) DISSERTATIO Medica Inaugularis, sistens Observationes ad vires Theæ pertinentes, auctore J. C. Lettsom. As this Dissertation is probably but in few hands,

abdomen, and into the cellular membrane of a frog, about three drachms of a highly scented
and

the following extracts from it, which contain his experiments at large, may not be unacceptable to my learned reader.

EXPERIMENTUM I. Sumpsi infusionis Theæ viridis, & Boheæ, liquoris post distillationem superstitis; nec non aquæ simplicis cujuslibet æqualem quantitatem, & in quemlibet liquorem, in vase suo contentum, immisi drachmas duas carnis bovis, ante duos dies macerati.

Caro bovina, immersa in aquam simplicem, post quadraginta octo horas corrupta, putridaque devenerat; dum portiones carnis in reliquas tres Theæ infusiones immisæ, post septuaginta demum horas putredinis indicia monstrabant.

EXPERIMENTUM II. Viridis atque Boheæ Theæ, saturatis infusionibus addidi æquales portiones salis martis, & protinus utrumque infusum colorem æqualem, profunde nigrum, acquirebat.

Ex enarratis experimentis tuto concludere licet, Theam & viridem & Boheam manifesta virtute antiseptica, ac adstringente in fibris mortuis, & vi vitali carentibus, gaudere; verumtamen propria, et etiam aliorum, experientia edoctus, certus scio, eam, in ventriculum ingestam, præsertim in subjectis tenerioris & delicatioris compagis solidæ, insignem potestatem relaxantem exhibere.

1. Potum hunc usitatum forma aquæ calidæ, aut fervidæ, sumendi mos invaluit, & inde nonnulli deducere voluerunt effectum, atque vim debilitantem potius huic vehiculo, quam herbæ ipsi tribuendam esse. Verum enimvero omnia experimenta, curiosius capta, in eo consentiunt, quod Thea viridis, & præcipue illa, quæ subtilissimum,

and pellucid liquor, exhibiting no signs of astringency, nor of oil floating on its surface, which had been

subtilissimum, atque maxime penetrabilem, spargit odorem, multo majori gradu virtutem relaxantem, quam Thea Bohea dicta, præstet. Id quod animum mihi addidit investigationes inceptas ulterius atque plenius prosequendi.

2. Hoc sine libram dimidiam herbæ Theæ viridis optimæ notæ, & admodum fragrantis, cum aqua simplici distillavi, atque aquæ insigniter odoratæ, pellucidæ, unciam unam, quæ nullum oleum in superficiem excutiebat, neque ulla virtutis adstrictivæ exhibuit indicia, elicui.

3. Eam partem liquoris, quæ finito stillicidio in vase distillatorio remansit, ad extracti consistentiam evaporavi, quod levem odorem, attamen saporem valde amarum adstringentemque habebat. Extracti acquisiti copia uncias quinque totidemque drachmas æquabat.

EXPERIMENTUM III. In abdominis cavitatem, atque membranam cellulofam ranæ injeci circiter tres drachmas aquæ stillatitiæ odoratæ. (No. 2.) Post viginti minuta alterum ranæ crus, seu pes posterior, multum adficiebatur, dum parum mobilitatis, aut sensibilitatis, monstrabat, quæ adfectio per quatuor horas perseverabat, & rana in statu torpido insensibili universali ultra novem horas manebat, donec gradatim ad pristinum vigorem rediret.

Simili ratione liquorem a distillatione Theæ viridis (No. 2.) superstitem, atque ulteriori evaporatione magis concentratum injeci, sed inde nullum effectum sensibilem inductum vidi.

EXPERIMENTUM IV. Nervis Ischiaticis ranæ denudatis, atque cavitati abdominis, aquam stillatitiam fragrantem (No. 2. & Exp. III.) adplicui, intra dimidiam horam extremitates

been distilled from half a pound of fine hyson tea. In twenty minutes the hinder extremities of the frog were strongly affected, and continued so four hours, whilst the animal remained in a torpid insensible state upwards of nine hours, and then recovered by degrees its former vigour. He made the same experiment with the *residuum*, left after distillation, which produced no sensible effect.

“ HE applied to the ischiadic nerves of a frog, when laid bare by dissection, and to the cavity of the *abdomen*, the same scented, distilled liquor

extremities posteriores, penitus paralyticæ insensilesque deveniebant, & post horæ circiter spatium rana vivere desit.

Liquorem a distillatione residuum No. 2. & Exper. III.) eadem ratione alii ranæ admovi, sed nullos inde natos observare potui effectus sedantes, immo virtutem magis stimulantem, quam sedativam, præstare videbatur.

Extractum (No. 3.) in aqua solutum, & sub iisdem conditionibus, iisdem partibus admotum, nullum effectum sensibilem produxit.

4. Experimenta hæc enumerata nullis commentariis egent. Extra omnem dubitationis aleam ponere videntur, quod effectus Theæ sedativus & relaxans a principio odorato, volatili, aromatico, potius, quam ab aqua calida dependeat. (No. 1) Non pauca utriusque sexus subjecta mihi innotuerunt, quæ maxima molestia & anxietate torquebantur, quotiescumque unum tantum poculum infusi Theæ potaverant; quæ tamen, consortio gratificandi ergo, aquam calidam, loco & more infusionis Theæ, sine ullo effectui incommodante hausserunt.

mentioned

mentioned above. In half an hour the hinder extremities became totally paralytic, and about an hour afterwards the frog died. The *residuum*, after distillation, was applied to another frog under the same circumstances, but seemed to produce rather an astringent and stimulating, than narcotic effect. He prepared an extract from this *residuum*, which being dissolved in water, and used in a similar manner, had no visible operation."

THESE experiments shew, that the pernicious effects of tea depend on its more volatile parts, which are dissipated in a great degree by long keeping, by hasty drying, or by reducing it to the form of an extract. I have seen and tasted of such an extract, made in the East Indies, which, though bitter and astringent, was by no means unpalatable. A preparation of this kind, dissolved in hot water, would be a good substitute for the leaves of the tea plant.

BUT however cogent the objections may be, against the general and too frequent use of tea, it must be acknowledged, that it is capable of being applied to very important, medicinal purposes. From its sedative power, and the weakness which it suddenly induces, it might be administered with advantage in ardent and inflammatory fevers, in order to abate the force, and lessen the inordinate action of the *vis*
vitalis.

vita. In such cases it should be given, either in substance, or in strong infusion; and besides allaying the troublesome sensations of heat and thirst, which are the constant concomitants of those distempers, it would probably serve as a good substitute for some of the usual evacuations. And thus instead of producing watchfulness, which is a common effect ascribed to it in weak habits, it would in all likelihood prove the safest and most salutary opiate. After a full meal, when the stomach is oppressed, the head pained, and the pulse beats high, tea is a grateful diluent, and agreeable sedative. And as studious, sedentary men are particularly subject to indigestion and the head ach, it is on this account justly stiled “the poet’s friend.” Other uses, to which tea is applicable, might easily be pointed out; but I have already made too long a digression.

THE twenty-ninth experiment affords a further proof, that the astringent parts of the *cortex* are as well extracted by maceration as by decoction. But I am inclined to think from this, and many other trials, that the astringent quality of this medicine is not so great as it is commonly reputed to be: and consequently the prejudice entertained against the use of it, in cases where powerful astringents are supposed to be contraindicated, is without sufficient foundation. Thus it hath been a commonly received rule, not to exhibit the bark

in intermittents, before the disease has in some measure spontaneously abated; and then to administer it only in the intervals of the fits (*b*). But this extreme caution, as it took its rise at first from false theory, is found, by later experience, to be in most instances unnecessary; and the *cortex* is now frequently given, with the utmost safety and success, after previous evacuations, not only at the commencement of the disorder, but even just before the accession of the cold fit. This was the common method of exhibiting the bark, when it was first introduced into Europe (*i*). But Sydenham informs us, that not long after, it came into disuse, for two reasons; *Primò quia paucis horis ante adventum paroxysmi, pro recepto id temporis more, exhibitus ægrum nonnunquam è medio tolleret. Funestior hic pulveris exitus, quamvis oppidò rarus, medicos tamen paulò cordatiores ab ejus usu meritò retraxit. Secundò quia æger ope pulveris, à paroxysmo aliàs invasuro liberatus, quod plerumque eveniebat, tamen intra dies 14. recidivam ut plurimum pateretur, in morbo scilicet recenti,*

(*b*) CURANDUM est ante omnia ne præmaturè nimis hic cortex ingeratur, ante scilicet quam morbus suo fomite aliquantisper protriverit.

Sydenham. Opera. p. 57.

(*i*) THO. BARTHOLIN. Hist. Anatom. Medic. Cent. 5, p. 108.

necdum

necdum temporis cursu suoque Marte committigato (k).

The last objection would have been obviated by a longer use of the bark; the first is totally without foundation. For the very few instances of mortality (Sydenham only enumerates two) which immediately succeeded the exhibition of the *cortex*, were not to be ascribed to the operation of the powder, but to the violence of the cold fit, which, in all likelihood, would have carried off the patients, had no medicine been administered. For the natural tendency of the bark is to moderate, and not to increase, the force of the paroxysms. And so far is it from producing obstructions, when given with proper precautions, at the beginning of intermittents, that it effectually prevents them, by putting a speedy stop to the disease, the continuance of which, in weak habits, is the true cause of their formation. “I am convinced,” says Mr. Cleghorn, in his excellent treatise on the diseases of Minorca, “that the unhappy *metastases*, “which some have observed to follow the use of “the bark, are exceedingly rare, and ought “rather to be ascribed to other causes, than to “this medicine. And I will venture to affirm, “that more bad consequences ensue from giving “it too late than too soon; prostration of strength, “sudden death, or the most obstinate chronic

(1) Sydenhami Opera, p. 265.

“diseases,

“ diseases, being the usual effects of delay.
 “ Whereas the worst that commonly happens,
 “ from the too early use of it, is that it does not
 “ at once restrain the paroxysms like a charm,
 “ without any sensible evacuation, as it frequently
 “ does, when given after the fever has arrived
 “ naturally to its height, and begins to decline of
 “ its own accord(*n*).” In another part of his
 work, the same ingenious and accurate writer
 observes, “ that the great advantages, which
 “ accrue from the early use of the bark in
 “ tertians, are that it invigorates the powers of
 “ the body, prevents or removes the dangerous
 “ symptoms, and brings on a crisis soon, and
 “ with little disturbance. Instead of suppressing
 “ any beneficial discharge, as some have asserted,
 “ we daily observe a laudable separation in the
 “ urine; warm, profuse, universal sweats; plentiful
 “ bilious stools; and sometimes the hæmorrhoids
 “ and menses coming on after it has been used;
 “ though it effectually restrains the colliquative
 “ night sweats, to which persons, weakened by
 “ tedious intermittents, are incident(*o*).” Mor-
 ton, who had great experience of the innocence
 and efficacy of the *cinchona*, frequently prescribed
 it, without premising any evacuations; and he

(*n*) Dis. of Minorca, p. 206.

(*o*) Id. p. 189, 190.

asserts that, after twenty-five years practice, he never knew the least bad consequence ensue from its exhibition, nor had ever occasion to repent the use of it. Dr. Lind informs us that, for three years past, he has annually prescribed upwards of one hundred and forty pounds weight of bark, and never observed any bad symptoms which could with propriety be ascribed to its use, except in two instances; in one of which it was supposed, though perhaps without sufficient foundation, to have occasioned an obstruction of the *menfes*; in the other, it produced a fit of suffocation in an asthmatic patient, probably owing to its being given in substance, and in too large a dose (*p*). A celebrated professor at Vienna has related a number of curious cases, which fully evince the safety and efficacy of the bark in semitertian, miliary, and malignant fevers. *Cortex peruvianus, vel declarante se malignitate, aliquamdiu post eruptionem exanthematicum, vel cum ipsa exanthematicum eruptione, vel etiam ante eruptionem eorum, vel ab ipso morbi principio, illicò summo cum effectu datus est* (*q*). In the inoculated small-pox, instances have been known of severe ague fits attacking persons, between the in-

(*p*) *Vide* Lind on the hot Climates, p. 294.

(*q*) *Vide* De Haen. Rat. Medend. vol. I. p. 166, 264, 265. Paris.

fertion of the variolous matter, and the eruption of the pock, when the bark hath been given liberally and with success, the principal business in the mean time suffering no injury or interruption (*r*). And in the confluent small-pox, a very free use of it has not appeared, in a variety of cases, to have abated the spitting (*s*). The retrocession of the morbid acrimony, in the measles, is prevented by nothing more powerfully than by the *cortex*, which obviates the secondary fever, allays the cough, and continues the efflorescence on the skin, even to the twelfth day: Whilst the disease runs through its accustomed stages with the utmost regularity, and creates much less disturbance and alarm than usual (*t*).

I HAD lately under my care a patient, who was seized with an intermittent, whilst he laboured under a severe *gonorrhœa*. The bark was given him in large quantity; and so far was it from suppressing the discharge, that it evidently increased it, and at the same time diminished its virulence. The late Dr. Whytt informs us that he swallowed, in sixteen days, near four ounces of it in substance, when he laboured under a catarrh-

(*r*) *Vid.* Dimisdale on Inoculation, p. 12; *vid.* also the Monthly Review for Sep. 1766, p. 189.

(*s*) Medical Transactions, vol. I. p. 469.

(*t*) *Vid.* Dr. Cameron's Paper, Med. Museum, p. 281.

ous cough, without feeling any bad effects from its astringent quality. In a tertian, attended with a cough and spitting, after the use of vomits and some pectorals, he prescribed the *cortex* in the usual quantity, without the breast being any way hurt by it. And he had repeated experience of its virtues, in curing a hoarseness after the measles, when unattended with a fever, or difficult respiration. In the whooping cough also, when given early, he found it one of the best remedies(*u*). The bark has been successfully administered, in the quantity of a drachm every three hours, to a woman two days after her delivery, without lessening the *lochia*; and it has been frequently given to others, during their *catamenia*, without the least interruption of them(*x*). These facts sufficiently evince the common apprehensions, concerning the astringent quality of the *cinchona*, to be groundless. And it may be hoped, that all such prejudices against the use of it will now vanish; as by its efficacy in the cure of scrophulous, glandular tumours, it is proved to be even a powerful deobstruent.

THE property of striking a black colour with green vitriol hath been ascribed to all vegetable astringents, without exception, and hath hitherto

(*u*) Whytt on Nervous Disorders, p. 241.

(*x*) Medical Transactions, vol. I. p. 469.

been regarded as an infallible test of their astringency (*y*). But from the twenty-ninth, thirtieth, and thirty-first experiments, it is evident, that neither the one, nor the other are strictly and universally true. For gentian appears to be endowed with no inconsiderable astringent power, and yet the infusion of it suffers not the least change from the addition of *sal martis*. On the contrary, the infusion of rue has no degree of astringency on the dead fibre, and yet it strikes a faint black with green vitriol.

THE action of acids in neutralizing vegetable bitters, as described in the last section, naturally led me to try their effects on the animal bitters. For this purpose, I procured a quantity of fresh ox-gall; but being prevented for several weeks, by various avocations, from pursuing my experiments, I found the gall at the end of that term extremely putrid. This accident pointed out to me a train of inquiries, somewhat different indeed from what I had at first proposed to myself, but which afterwards appeared to be much more

(*y*) THE power by which they produce this blackness, says a celebrated chemist, and their astringency, or that by which they contract an animal fibre, and by which they contribute to the tanning of leather, seem to depend upon one and the same principle, and to be proportional to one another.

Lewis Com. Ph. Tech. p. 345-

interesting and important. I shall therefore make no apology for laying before the reader the result of them.

EXPERIMENT XXXIII. Putrid ox-gall, diluted with water, struck a green colour with syrup of violets, and sensibly effervesced with oil of vitriol, became turbid and of a light yellow colour. This experiment was repeated several times, and always with the same success; so that I am pretty confident there must have been some error in that trial of Dr. Macbride's, from which he concludes, "that putrid ox-gall shews no sign of alkali; it
"neither effervesce with acids, nor does it
"change the colour of the blue juices; neither
"does it throw down any precipitate from the
"solution of corrosive sublimate(z)." At first it occurred to me, that the mistake, into which this very ingenious and accurate experimentalist hath fallen, might arise from his not diluting the gall before he added the acid; by which the latter would be so inviscated, as not to give sufficiently evident signs of effervescence. But afterwards the curious observations of M. Gaber of Turin, concerning putrefaction, suggested to me a still more probable source of fallacy, to which Dr. Macbride was exposed. That learned Italian hath clearly proved, "that the marks of alcalinescence, in putrify-
"ing animal substances, are greater or less, or

(z) Macbride's Essays, p. 101.

“ none at all, according to the time the experi-
 “ ment is made, after the putrefaction begins;
 “ that such substances, upon their first putrefaction,
 “ do not effervesce with acids; that afterwards
 “ they effervesce manifestly with them; but that
 “ at length they cease from doing it, though the
 “ putrefaction still continues (*a*).” Now it is not
 unlikely that Dr. Macbride’s trial on the ox-gall,
 was made either before the volatile alkaline salt
 was formed, or after it was evaporated; as Sir
 John Pringle candidly acknowledges to have
 happened, in his experiments on putrid substances.

EXPERIMENT XXXIV. To two drachms of
 putrid ox-gall, diluted with half an ounce of
 water, were added twenty drops of *ol. vitriol*.
 A light yellow cloud instantly formed itself, and
 the mixture slightly effervesced and became tur-
 bid: But though the peculiar fetor of the gall
 was destroyed, yet it emitted a strong and dis-
 agreeable smell, nor was its bitter taste entirely
 corrected. Thirty drops rendered the mixture
 rather sharp to the taste; but still the bitterness
 was perceptible: Nor did forty drops entirely
 destroy it, although that quantity made the
 mixture very sour. After standing a while, it

(*a*) *Vid.* Miscellanea Phil. Mathem. Societat. Privat.
 Taurinensis: *vid.* also, Pringle on the Diseases of the
 Army, Append. p. 125.

assumed a deep green colour, a sediment gradually formed itself, which in twenty-four hours subsided to the bottom of the glass, and left the liquor above almost clear.

EXPERIMENT XXXV. To the same quantity of putrid gall and water, as in the former experiment, were added forty drops of white wine vinegar. The putrid fetor was entirely destroyed, and no other disagreeable smell was produced in its room. The mixture became turbid, but in a less degree than the former with the oil of vitriol; and the effervescence was likewise much more obscure. Sixty drops of vinegar seemed nearly to neutralize the gall. For though some small degree of bitterness remained, it was very trifling, and by no means unpalatable.

EXPERIMENT XXXVI. To a third glass of gall and water, mixed together in the above-mentioned proportions, were added forty drops of juice of lemons. The mixture became turbid, but the putrid smell was not perceptibly covered. A hundred and twenty drops neutralized the mixture, entirely correcting both the odour and taste.

1. FROM these experiments may be deduced, the great utility of acids, in all diseases which either proceed from, or are accompanied by a redundancy and depravation of the bile. And this seems to be the case with most autumnal fevers,

fevers, and in general with the epidemics of all hot countries, especially where heat and moisture are conjoined. For the former promotes the generation, and the latter the putrefaction of the bile. I have been assured, says Dr. Bryan Robinson, by a very knowing butcher, that animals have least bile in January, and most in July(*b*). And Hippocrates hath observed, *Æstate sanguis adhuc viget, sed et bilis exaltatur; per æstatem etiam ac autumnum bile corpus abundat; autumno autem atra-bilis plurima est et fortissima*(*c*). Mr. Cleghorn, in his account of the diseases of Minorca, informs us, that he examined the bodies of near a hundred persons, who died of tertian fevers, and that he constantly found the *vesica fellea*, and the stomach and intestines overflowing with bilious matter(*d*). The testimony of Prosper Alpinus likewise, strongly confirms the truth of this observation. He says, *Alexandriæ autumno grassantur febres pestilentes multæ lethales, quæ fere quamplurimos invadunt. His vero notis pleræque dignoscuntur: In principio enim vomitus multi, biliosi ac virulenti observantur, à quibus cibum assumptum continere nequeunt, assiduisque corporis agitationibus, inquietudinibusque vexantur, stomachique angore anguntur. In pleris-*

(*b*) Robinson on the Operation of Medicines, p. 48.

(*c*) Hippocrates lib. de. Nat. Hom. sect. 14.

(*d*) Dis. of Minorca, p. 165.

que etiam observantur multæ symptomaticæ dejectiones liquidæ, biliosæ, variæ, admodum ægrè olentes sive fæcentes (d). The yellow fever of the West Indies is always at the beginning attended, with great sickness, violent reaching, and a copious discharge of bile. The vomiting recurs at short intervals, often becomes almost incessant, and an incredible quantity of bile is sometimes thrown up in a few hours (*e*).

2. THE difference between the action of mineral and vegetable acids on putrid gall, as evidenced in the preceding trials, is deserving of particular notice. From the ignorance of this distinction, or want of attention to it, I believe the elixir of vitriol is often exhibited, when vinegar, or the four juices of vegetables, would be much more serviceable. For though it is the common property of all acids to *correct* the putrid acrimony; yet the power of *sweetening* it, seems to be peculiar to those of the vegetable class. And as they are mildly aperient at the same time, they will not only neutralize the septic *colluvies*, which in some diseases lodges in the stomach and flexure of the *duodenum*, but will also gently tend to evacuate it; an advantage not to be expected from the mineral acids.

(*d*) Alpinus de Medicin. Ægypt. lib. I. cap. 14. p. 51.

(*e*) Vide Hillary's Observ. on the Dis. of Barbadoes: Vide also Bislet's Medical Essays and Observations.

3. MR. BROWNE LANGRISH, in his *Modern Theory and Practice of Physic*, relates the case of a poor man who, after eating heartily of stale mutton, which he bought on account of its cheapness, was affected with vomiting and purging to a strange degree, and in all respects seemed as if he had been poisoned. Vinegar, diluted with water, contributed more than any other medicine towards his cure.

4. A TABLE SPOONFUL of the juice of lemons, unmixed with any thing, is said, by an ingenious writer, (*f*) to have repeatedly proved a certain cure for a palpitation of the heart, after many of the medicines, called antihysterical, had been tried in vain. This effect he ascribes to an uncommon disposition in the nerves of the stomach. But I think it is not improbable, that the complaint proceeded from bilious acrimony, which the vegetable acid corrected and neutralized. This conjecture is confirmed by a similar case, which Dr. Bisset hath related, of a middle aged gentleman, who had a palpitation of the heart, accompanied with some symptoms of the jaundice, and who was completely cured by drinking, every evening, weak rum punch, acidulated with the juice of Seville Oranges. (*g*)

(*f*) Whytt on Nerv. Disorders, p. 372.

(*g*) Bisset's Medical Essays and Observ. p. 254.

5. I HAVE been lately informed, by an ingenious practitioner, that he has seen four cases of a suppression of urine, supposed to arise from gravel in the kidneys, almost instantly removed by the juice of lemons. Not long after taking it, the patient voided a quantity of fabulous matter. In one case, a very painful chordee accompanied the complaint, which immediately yielded to the same medicine. All the patients were of bilious habits, and it is probable, the lemon juice resolved the spasms of the urinary passages, by correcting some putrid acrimony in the stomach, or by producing a grateful sensation in that organ. Sydenham recommends the juice of lemons, joined with manna, as a remedy for the gravel, and found, in his own case, that it rendered the purgative quicker in its action, and more agreeable to his stomach.

6. FROM the effect of acids on the gall, we may infer the reason why the immoderate use of them so much impairs digestion. The bile, in its natural state, is a saponaceous fluid, absolutely necessary to chylication; and whatever weakens its powers, must proportionably injure the due concoction and assimilation of our food. Hence the body is deprived of its proper nourishment and support, the blood becomes vapid and watery, and a fatal cachexy unavoidably ensues. This has been the melancholy lot of many unfortunate

fortunate persons, who, in order to reduce their excessive corpulency, have indulged themselves in the too liberal use of vinegar.

7. It is not improbable that the acidities, to which infants are peculiarly subject, arise as much from the weakness of their biliary secretions, as from the acescency of their food. The liver of a child is extremely lax, in its texture, and with respect to his bulk, is much larger than the liver of an adult: Hence the secretions of the one will be proportionably greater than the secretions of the other. But though the bile flows copiously, yet the powers of nature, in the state of infancy, are too feeble for its due preparation; and it is a mere watery, inert fluid, unfit for neutralizing those acidities, which in the more advanced stages of life, it is one part of its office to correct. And this, I apprehend, is a principal cause of their redundancy in the *primæ viæ* of children.

THE frequent opportunities, which the preceding course of experiments afforded me, of observing the effects arising from the combination of green vitriol and astringents, naturally led me to examine into the principles of INK. And as the subject is not only curious in itself, but also interesting and important, from its relation to the arts of dying and staining black, I was induced to institute a new set of trials, in order to the more clear

clear and accurate investigation of it. That a solution of vitriol strikes a deep black, with vegetable astringents, is a fact universally known; but Dr. Lewis is almost the only chemist who hath attempted to explain it. He is of opinion that the colouring matter of ink is iron, extricated from its acid in a highly attenuated or divided state, and combined with a peculiar species of matter contained in astringent vegetables. Acids, he says, destroy its blackness, by redissolving the ferrugineous particles; and alkalis, by uniting with the astringent matter, and precipitating the iron, nearly in the same ochrey state, as they do from the simple acid solutions of the metal (*b*).

BUT from the following experiments, I think it will fully appear that this very ingenious and useful chemist is mistaken; and that the colouring matter of ink is iron, not extricated from, but in combination with an acid.

EXPERIMENT XXXVII. To half an ounce of the decoction of galls, was added one grain of *sal martis*: An inky blackness succeeded. Sixty drops of *sp. c. c. vol.* discharged the black, and rendered the liquor thick, and

(*b*) Lewis Comm. Ph. Tech. p. 348.

brown coloured. A hundred and twenty drops of oil of vitriol restored the blackness; two hundred again discharged it, and gave the ink a yellow cast, inclining to green. This experiment is illustrated by the following one.

EXPERIMENT XXXVIII. One grain of green vitriol was dissolved in half an ounce of spring water: Forty drops of *sp. c. c. vol.* were added; a greenish yellow sediment formed itself, and presently subsided to the bottom of the glass, with little white flakes, which I at first judged to be calcareous earth, separated from the spring water by means of the volatile alkali. But the *sp. c. c. vol.* mixed with the same water, produced no precipitation. Oil of vitriol was then dropped in, to the point of saturation. When the effervescence ceased, the whole sediment was redissolved, and the mixture became quite clear.

EXPERIMENT XXXIX. A piece of polished iron was immersed in a cold infusion of the bark, made with distilled water. In three hours, the liquor was just perceptibly tinged with black. The piece of iron was then taken out, wiped clean, and again immersed in another infusion of the *cortex*, of equal strength with the former, made with common spring water. In less than two hours,

hours, the infusion assumed a deep purple colour, and the fluid in contact with the iron was of an inky blackness.

THIS experiment clearly proves, that an acid is necessary to the formation of ink. Spring water is generally impregnated with some of the mineral acids, in combination either with certain metallic substances, the fossil alkali, or calcareous earth. The water, employed in this trial, contained a considerable portion of selenitic salt; and hence it was capable of dissolving the iron, which was immersed in it, and of forming with it a perfect *sal martis*. This sufficiently accounts for the deep purple hue, which the infusion assumed. The distilled water was either not sufficiently pure (for I did not particularly examine it) or the *cortex*, which, like all other vegetable substances, is of an acescent nature, communicated to it a slight degree of acidity, by which the iron was corroded, and a faint and scarcely perceptible blackness produced.

EXPERIMENT XL. Three or four drachms of *sal martis* were dissolved in half a pint of boiling water. After standing a few days, that the ochre might precipitate, the solution was passed through brown paper. The filtered liquor was perfectly clear, discovered no marks of acidity to the taste, and struck a deep black with the
infusion

infusion of galls. In four or five days it let fall a very fine, light, yellow sediment, was again passed through the filter, and struck as before a deep black with the infusion of galls. I did not prosecute this experiment any further; being satisfied, from the trial I had made, that the acid and the iron, the component parts of green vitriol, are not so easily separated from each other, as is commonly supposed. And it is probable that the acid, after the precipitation of the ochre, still retains as much ferrugineous matter, as is sufficient to saturate it, when so much diluted with water.

EXPERIMENT XLI. From a large Copperas Work, established near Wigan, I procured a quantity of the yellow ochre, precipitated from green vitriol; and of a chocolate coloured pigment, made by exposing the ochre to such a degree of heat, as is sufficient to separate the acid, and give it what the painters term a BODY. Neither the ochre, nor the pigment were attracted by the magnet, a proof that they were both in a state of calcination. Three grains of the ochre, and the same quantity of the chocolate coloured pigment were added to two glasses, each containing half an ounce of a decoction of the bark. The pigment communicated to the decoction its own peculiar colour; but the yellow ochre struck with it a deep purplish black.

Twenty

Twenty drops of *sp. c. c. vol.* made no change in the decoction with the pigment; but the other instantly lost its black, and assumed a chocolate colour, exactly resembling that of the pigment.

EXPERIMENT XLII. THE result of the last experiment led me to imagine, that an alkali, dropped upon the ochre, would render it brown by abstracting its acid; and on the contrary, that oil of vitriol added to the chocolate pigment, would restore its yellow colour, and give it the property of striking a black with vegetable astringents. I therefore diffused four grains of the ochre, and the same quantity of the pigment, in two glasses of water. To one, I added twenty drops of *sp. c. c. vol.* to the other, the same quantity of *ol. vitriol.* The hartshorn immediately precipitated the ochre in fine, light flakes, but did not either effervesce with it, or alter its colour: The acid had no sensible effect on the pigment. Thus was I doubly disappointed in the issue of this experiment.

EXPERIMENT XLIII. A few drachms of the yellow ochre were well mixed with four ounces of spring water. As soon as the ochre subsided, the liquor above was carefully poured off, and passed through common filtering paper doubled. It had acquired a deep orange colour, was perfectly transparent, had an aluminous taste, and

was

was remarkably styptic and astringent in the mouth. A drachm of it struck a deep green, inclining to black, with half an ounce of the bark decoction. I instilled twenty drops of *sp. c. c.* *vol.* into a table-spoonful of it: No effervescence ensued, but a very copious, flaky, and yellow sediment was instantly produced. I kept the remainder of the orange coloured liquor, in an open glass vessel, for several weeks, without observing the least ochrey precipitation, or any diminution of its transparency. And this I apprehend is a proof, that a firm and lasting combination takes place, between certain proportions of the component parts of green vitriol.

THE same ochre was macerated in fresh portions of water, till the filtered liquor had neither taste, colour, nor the property of giving the least black tinge to an infusion of galls. The ochre was then dried by a very gentle heat, and two scruples of it were added to half an ounce of the same decoction of the bark, which was used in the former experiments; but no change of colour ensued, only the decoction assumed a lighter yellow, whilst the particles of the ochre floated in it.

EXPERIMENT XLIV. Spirit of hartshorn, dropped into a solution of green vitriol, occasioned a copious precipitation, but no effervescence. It cannot be alledged therefore, that the yellow ochre

contains no acid, because it doth not raise a sensible ebullition with the volatile alkali.

Thus it appears, that whatever deprives green vitriol of its acid, whether it be heat, the addition of an alkali, or repeated affusions of water, destroys its power of striking a black colour with vegetable astringents. May we not then justly conclude, that an acid is essentially necessary to this property, which, it is more than probable, depends upon the composition of the copperas as a mixt; and not upon either of its constituent parts separately taken? Ink therefore is a combination of vitriolic acid, iron, and a certain proportion of vegetable astringent matter (*i*). But as these principles bear but a weak relation to each other, their bond of union is easily dissolved, and it has long been a desideratum in chemistry, to

(*i*) An ingenious friend (Dr. Falconer of Bath) is of opinion, that a double elective attraction takes place in the production of ink. The acid forsakes the iron and combines with the vegetable astringent, separating from it the phlogiston, which unites with the iron. In support of this hypothesis he observes, 1. that mineral astringents, such as earth of alum, &c. precipitate iron, as well as those of the vegetable class; but affording no *phlogiston*, the precipitate is in an ochreous state. 2. That the black sediment of ink is easily soluble in acids, whereas the *calces* precipitated by alkalis are of very difficult solution, owing to the almost entire loss of their *phlogiston*. For a perfect calx is found to be absolutely insoluble.

render

render it more fixed and permanent. Acids by attracting the astringent matter, with which it is evident, from many of the foregoing experiments, they have a strong affinity, discharge the black colour of ink. Alkalis, on the contrary, decompose it, by abstracting the acid from the vitriol, and precipitating the iron. If the blackness hath been destroyed by an acid, the addition of an alkali in due proportion will restore it, and *vice versa*. The reason why they thus counteract each other's effects, is too obvious to require an explanation.

A RECAPITULATION OF THE

PRINCIPAL FACTS ASCERTAINED BY THE PRECEDING EXPERIMENTS.

1. **T**HE PERUVIAN BARK, and many other vegetable bitters and astringents, yield their virtues as perfectly to cold, as to boiling water.

2. As much of the resin of the bark is dissolved by cold maceration, as by coction.

3. TRITURATION promotes and increases the solution of the bark in water.

4. A STRONG infusion of the bark may, by means of triture, be prepared with great expedition.

5. QUICK LIME neither quickens, nor increases the solution of the bark in water.

6. THE BARK will not yield all its virtues either to cold water, boiling water, or rectified spirit of wine, nor probably to any other *menstruum* singly employed. After thirty cold macerations, and twenty-five coctions, in different portions of water, each *residuum*, though perfectly insipid, yielded a bitter and astringent tincture, when digested in rectified spirit of wine. On the contrary, after repeated digestions in rectified spirit of wine, when that *menstruum* acquired neither taste nor colour from the bark, cold water extracted from it a manifest degree of astringency.

7. COLD WATER is a more powerful solvent of the bark, than rectified spirit of wine. But brandy is a stronger solvent than water, and rhenish wine than brandy.

8. THE DECOCTION, and INFUSION of the Peruvian bark are very perishable preparations.

9. ACIDS, BITTERS, and ASTRINGENTS neutralize each other, forming what the chemists term a *tertium quid*. When combined together in due proportion, their taste and smell is altered; the acids lose the property of striking a red colour with syrop of violets; and their antiseptic powers, in combination, are double the sum of them
when

when separately employed. The bark likewise, with vinegar, hath the property of restoring sweetness to putrid substances, which Dr. Macbride affirms it hath not alone.

10. THE VEGETABLE ACIDS, combined with astringents, diminish their astringent power on the dead fibre; the mineral acids increase it.

11. ASTRINGENCY and BITTERNESS are distinct properties, and are united together in very different proportions, in different vegetables.

12. NEITHER the taste, nor the power of striking a black colour with chalybeates, nor yet the property of hardening animal fibres, whether singly, or collectively taken, are certain criteria of the astringent power of a medicine on the living body.

13. THE power of striking a black colour with green vitriol is not always a test of astringency on the dead fibre; nor is it common to all vegetable astringents. Rue yields a faint black, on the addition of *sal martis* to an infusion of it, and yet is not astringent: Gentian, on the contrary, strikes no black, although it is a pretty strong astringent.

14. PUTRID GALL is neutralized by all acids. But those of the native vegetable class alone entirely sweeten it.

15. WHATEVER deprives green vitriol of its acid, whether it be heat, the addition of an alkali,

alkali, or repeated affusions of water, destroys its power of striking a black colour with vegetable astringents.

16. AN ACID, contrary to the opinion of Dr. Lewis, appears to be essentially necessary to the above-mentioned property of green vitriol.

17. INK seems to be a combination of vitriolic acid, iron, and a certain proportion of vegetable astringent matter.

E S S A Y IV.

ON THE

USES AND OPERATION

OF

B L I S T E R S.

Certè hinc lucis aliquid erui poterit, quâ id tandem, in quo medicorum diligentiam desidero, effici queat, ut accurata de vesicantium in diuturnis affectibus præcepta tradantur, quæ et perspicuitatem habeant, et quasdam errare in mendo non patientes vias.

FREIND.

THOUGH the action of cantharides, as vesicatories, was not unknown to the ancients, their application did not prevail much in practice, till the beginning of the last century. And as nothing hath tended more to enlarge the boundaries of science, than the contentions of the learned, we perhaps owe, in a good measure, our present more accurate acquaintance with the virtues and operation of blisters, to a dispute amongst the Italian physicians, relative to their

use in a plague, which prevailed about the years 1575 and 1590. But though blisters are now almost universally employed, and experience hath ascertained their utility in various disorders, the theory of their action, as well as the mode of their operation, is yet undetermined, and remains a subject of litigation. Hence arises that diversity of opinion concerning the diseases in which they are indicated, the time of their application, and the parts to which they ought to be applied. Nor can we ever hope for uniformity in this particular, amongst physicians, either with respect to their opinions or their practice, till a juster idea be formed of their mode of action, deduced from experience, and an attentive observation of their effects on the human body. When this is accomplished, a system of rules may be laid down for their right and advantageous application.

MEDICINES are generally divided into such as act, 1. on the solids, 2. on the fluids: And blisters may be considered as belonging to each of these classes; though their relation is chiefly to the former. But here a question occurs, whether vesicatories produce their effects by their external action on the body, or by the absorption of their stimulating particles into the system? Baglivi furnishes us with two curious, though cruel experiments, of the injection of two ounces of the
tincture

tincture of cantharides, into the jugular veins of a dog and a whelp. Great anxiety, violent pain, insatiable thirst, convulsions, and death, were the consequences in each instance. But no certain or just inferences can be drawn from these experiments; because medicines are not administered by injection into the blood vessels; and substances, much less acrid in their nature than cantharides, if conveyed directly and undiluted into the course of circulation, will be found to produce effects similar, or at least equally deleterious (*k*). When taken by the mouth, in an over-dose, the most dreadful symptoms succeed; an exulceration of the bladder and *urethra*, inflammation of the bowels, violent pains in the *hypogastrium*, extreme thirst, a high fever attended with delirium; and at last death closes the melancholy scene. The like effects, it is said, though in a less degree, have been observed to arise from the application of blisters. And it is upon these active powers of cantharides, when absorbed into the system, properly modified and seasonably applied, that the effects of vesicatories are supposed, by several learned writers, chiefly to depend (*l*). The quicker contractions of the heart and ar-

(*k*) New milk, injected into the veins of a dog, proves a mortal poison. Young on Opium, p. 6.

(*l*) Baglivy, Freind, Glafs, Huxham, &c. &c.

teries, in consequence of their application in certain disorders, they ascribe, not to a sympathy with the skin, but to a stimulus circulated with the fluids, and acting immediately on the vessels themselves. And as Baglivi hath asserted that cantharides have the property of colliquating the blood, when mixed with it out of the body, they apprehend that the good effects of blisters, in fevers attended with a glutinosity and lentor in the fluids, arise principally, if not entirely, from their attenuating and dissolving powers. But this theory of the operation of vesicatories is liable, I think, to many objections.

1. IF their action depend upon the stimulus of the absorbed cantharides, they should in all cases quicken the contractions of the vascular system. But this is contradicted by experience; for in pleurifies, peripneumonies, and other inflammatory diseases, when the heart and arteries are already acting very strongly, they abate the inflammation, and lower the pulse (*m*).

2. THE small portion of cantharides, which may be carried into the course of circulation by the lymphatics of the skin, cannot I apprehend be adequate to the effects ascribed to it, whether we consider the large mass of fluids with which it is mixed and diluted, or the coats of the vessels

(*m*) Whytt's Experiments, Ph. Transact. vol. L. p. 2.
lined

lined with a mucus, which must defend them from any slight degree of acrimony. It may indeed be said, that the usual effects of a blister on the urinary passages shew, that the particles of cantharides are absorbed in sufficient quantity, to irritate and vellicate the internal parts of the body. But allowing this objection its full force, by granting what is disputed by some, that the strangury arises from the immediate action of the flies on the urinary passages, this by no means proves their stimulating power, when circulating with the general mass of fluids. All extraneous bodies introduced into the blood, and not capable of being animalized, pass off by one or other of the excretories. If they be of such a nature as to be volatilized by the common heat of the body, they are eliminated by the lungs and pores of the skin, along with the matter of insensible perspiration. Garlic, onions, asafoetida, sulphur, and most of the essential oils, afford examples of this kind. But if the extraneous matter be less volatile, if it be incapable of chemical mixture with the blood, or if it unite only with the serum, it will be carried to the kidneys, and pass off by urine. Of this nature are cantharides(*u*); and

(*u*) BAGLIVY, on mixing cantharides with the serum of the blood, found the powder precipitated soon after to the bottom of the vessel, without having produced any change in the colour of that fluid.

when

when their acrid particles are, in continual succession, applied to the highly sensible and nervous membrane, which lines the urinary ducts, can we wonder at the strangury, and other painful effects which they produce (o) ?

3. THE same objection may be made to the attenuating power of cantharides, as introduced into the blood by means of blisters. Is it at all probable that a few grains of cantharides can act so powerfully, as to dissolve a general lentor and viscosity of the whole mass of fluids ? Mercury, it is true, in a very small quantity, will excite a salivation : But it does not produce this effect, by breaking down the *crasis* of the blood, though the continued use of it may have that tendency, but merely, as I conceive, by its partial stimulus on the salivary glands. An eminent practitioner informed me, that he had more than once ordered blood to be taken from patients under salivation, which he found not in a dissolved, but

(o) It is not improbable, that the nerves of the urinary passages are disposed to be more irritated by the acrimony of the flies, than those which are distributed to the other organs of the body. For Dr. Whytt hath ingeniously proved, that the different operation of medicines depends very much on the particular nature and diversified sensibility of the nerves of different parts of the body ; by which they are differently affected by the same kind of stimulating substances.

Vid. Essay on Nerv. Dis.

even

even in a buffy state. But it may be presumed, I think, that cantharides are not possessed, in any considerable degree, of a colliquative power; for they have no chemical relation to the animal fluids, and Sir John Pringle hath proved that they are by no means septic(*p*). As this, however, is a point of some importance, the two following experiments were repeated, after Baglivi, in order to determine it.

EXPERIMENT I. Four ounces of blood, just drawn from the arm, were divided into two equal portions; to one was added ten grains of *pulv. santharid.* the other was kept as a standard. The portion with cantharides coagulated at the same time with the standard, and neither assumed a sublivid, nor an ash colour. Its surface was covered with a thin pellicle, but without the vesicles Baglivi describes. After standing a few hours, the crassamentum in part dissolved, as appeared from the colour of the serum, which was tinged with red; owing perhaps to a slight degree of agitation, which was used to mix the cantharides with the blood when fresh drawn.

THE portion without the cantharides separated into a clear, pale coloured serum, and a tough, ash coloured crassamentum; the surface of which contracted into the compass of a shilling, and

(*p*) Append. to Dis. Army, Exp. 22.

retained that form till the putrefaction began; which happened sooner in the standard, than in the other portion of blood.

EXPERIMENT II. Ten grains of *pulv. cantharid.* added to two ounces of serum, tinged by the crassamentum of a light, florid, crimson colour, rendered it more liquid, and changed it to a dull red. Contrary to the assertion of Baglivi, it coagulated with great ease, and with less heat than an equal portion of the same serum, without cantharides.

5. THE chief symptoms induced by blisters may be rationally accounted for, without having recourse to the absorption of the acrid particles, of which they are composed. These symptoms are a quick pulse, dryness of the tongue, thirst, strangury, &c. They quicken the pulse in the low state of fevers, by their stimulus on the skin, with which the whole vascular system sympathizes. They occasion thirst, dryness of the tongue, and an increase of fever, in the same way, viz. by their external irritation. But these effects ought to be ascribed to the improper and unseasonable use of blisters. When the inflammatory *diathesis* prevails universally and strongly, without any partial obstruction, every stimulus must aggravate the symptoms; and blisters raised on the skin, by a cataplasm of mustard, or by the actual or potential cautery, where the irritation is confessedly

cessedly external, would operate in the same manner as an epispastic of cantharides. But in cases wherein vesicatories are indicated, I have never found, on the strictest examination, the least increase of thirst, or dryness of the mouth, in consequence of their application(*q*). The
strangury

(*q*) THE three histories, which Baglivi relates, of the effects of epispastics, carry very little authority with them; because the blisters were either ill-timed, or laid on in too great numbers. The first case is that of a young man, of a bilious temperament, who, after being heated, suddenly exposed himself to the cold wind. He was seized with an *angina*, which terminated in a violent pleurisy, attended with the strongest symptoms of inflammation. Six vesicatories were applied at once, to different parts of his body; the consequences of which were, a suppression of the *sputum*, tremors, convulsions, delirium, and death. The second history is that of a cook, who was attacked with a convulsion of the lower jaw, which was soon after succeeded by spasmodic contractions of the abdominal muscles. The *pulvis cornachini* was prescribed, and the next day four blisters were applied. Vomiting, convulsive motions, and an oppressed breathing ensued. On the fourth day he died. This case was probably a locked jaw; a disease too frequently fatal. The third history is that of a young and slender woman, eight months advanced in pregnancy, who, after suffering much pain, was at length delivered. The pain however still continued, accompanied with an uncommon tension of the belly. Four blisters were applied at one and the same time, as in the former instances.

strangury has by some been supposed to arise, not from an absorption of cantharides, but from a sympathy between the skin and the urinary passages. And it is urged, that a warm fomentation of milk and water, applied to a blistered part, very quickly relieves this complaint, by removing or diminishing the irritation on the surface of the body. But I confess the probability lies on the other side of the question; and several reasons incline me to think, that the strangury is produced alone by the absorption and internal stimulus of the flies.

I. NEITHER mustard, the actual or potential cautery, nor any other vesicating stimulus but cantharides, excite this complaint. And is it not strange, that the urinary passages should have such an universal sympathy with all the different parts of the body, to which

stances. The *lochia* were immediately suppressed, convulsions came on, and at last the poor patient fell a victim to death. Baglivius de Vesicant. p. 70.

FROM the application of so many blisters, it is not to be wondered, that the thirst, quickness of the pulse, and other symptoms of acute diseases were, according to the experience of Baglivi, greatly aggravated. Besides, it is more than probable, that vesicatories are attended with greater inconveniences in warm, than in cold climates, because the inhabitants of the former are generally of more irritable constitutions, and of more adust and bilious temperaments, than those of the latter.

cantharides

cantharides are applied, whilst no such consent takes place, when any other vesicatory is made use of?

2. DRINKING plentifully prevents the strangury; and surely it can produce this effect in no other way, than by diluting, in the kidneys and bladder, the acrimonious particles of the flies.

3. A BLISTER, laid upon the head immediately after shaving, is almost always succeeded by the strangury; whereas no such effect takes place, if the application be delayed twenty-four hours. How are we to account for this fact, unless by supposing, that the subtler parts of the cantharides enter more readily, and in greater quantity into the blood, after the scarf-skin hath been removed by the razor? The effect of a warm fomentation, in alleviating the troublesome symptoms of this complaint, arises partly, from its sedative operation on the whole system, but chiefly, I imagine, from its washing off all those acrid particles adhering to the skin, which would otherwise enter into the blood, and increase, or at least continue the irritation in the urinary passages.

BUT though it be acknowledged, that the strangury is occasioned by the stimulus of the cantharides, acting internally, yet the ex-

planation, given above, of this effect removes, I think, every objection to what has been advanced. I shall proceed therefore to consider the operation of blisters, according to the division already laid down.

THE diseases of the SOLIDA VIVA, in which they are indicated, are very numerous; but taking a more general view of them, they may perhaps be reduced to three kinds.

1. WHEN THE ACTION OF THE MOVING FIBRES IS, EITHER PARTIALLY OR UNIVERSALLY, TOO WEAK.

2. WHEN IT IS IRREGULAR.

3. WHEN IT IS PARTIALLY TOO STRONG.

IN the first case vesicatories are indicated, as a stimulus to the languid solids, to rouse them to more vigorous contractions, to support the *vis vitæ*, and to promote the salutary secretions. They tend to quicken the circulation, to raise the pulse, and to animate the whole system. Hence we may deduce their use and operation,

1. IN LOW NERVOUS FEVERS; when the spirits sink, when the contractions of the heart grow languid, and the unhappy patient struggles under anxiety, restlessness, delirium, difficulty of breathing, and a load and oppression about the *præcordia*. These symptoms arise from debility, and denote a kind of
nervous

nervous orgasm, or spasm of the vitals, which requires cordial medicines, aided by the application of blisters (*r*). An eminent practitioner hath indeed observed, that in these fevers, epispastics sometimes aggravate all the symptoms, and by their irritation occasion a small and contracted pulse. But this he ascribes to a mistake, either in the time, or place of their application. On the first signs of a delirium, when the urine turns pale, when the patient sighs, is anxious, and becomes dull of hearing, or when his eyes sparkle and look staring, &c. he advises to cover the whole head with a blister. The epispastic will thus be applied as nearly as possible to the part affected; and as the head is less sensible to the stimulus of cantharides, than any other part of the body, all the bad effects, arising from too great irritation, will be prevented (*s*). Baglivi long ago remarked, that blisters sometimes excite a small and contracted pulse; and I apprehend in the class of diseases, now under consideration, their utility must always be attended with a peculiar degree of uncertainty. This depends on the nature of these fevers, and the concomitant state of the nerves.

(*r*) *Vide* Huxham on Fevers, p. 82.

(*s*) *Vide* Med. Essays of Edinburgh, vol. IV. Art. 23.

Whenever they are accompanied with little pain, but with a high degree of irritability, which is not unfrequently the case, blisters, I think, will be found to be prejudicial, by increasing the spasm, and throwing the system into confusion. But if the body, however languid and enfeebled, has been accustomed through the course of the disease, to the stimulus of pain, or if the nerves be not affected with an excess of sympathetic sensibility, epispastics may be applied with safety and advantage.

2. IN the advanced state of INFLAMMATORY FEVERS, when the patient becomes languid, or perhaps comatose, blisters are highly serviceable. And they are found to be very efficacious in removing those obstinate and oppressive head-achs, which have resisted every previous evacuation, and which often continue to the last period of the distemper (*t*). The same observation holds true in every other species of fever, where such a train of symptoms occur as have been already described.

EVEN in malignant PETECHIAL FEVERS, notwithstanding the great dissolution of the blood, and the supposed tendency of cantharides to increase that dissolution, some of the most eminent

(*t*) *Vide* Pringle's *Dis. of the Army*, p. 134.

practitioners have been bold enough to recommend blisters. Thus Riverius says, *Ubi maxima est malignitas, unicum vesicatorium non sufficit, sed plura admovenda sunt; soleo ego in magna morbi sævitiâ, quinque locis admovere, cervici nimirum, utrique brachio, parti interiori inter cubitum et humerum, et utrique femori, parti etiam inferiori inter inguina et genua, cum felici successu (u)*. Etmuller, treating of the same fevers, asserts, *Si ulla est febris in qua vesicatoria conveniunt, est imprimis petechialis (x)*. And in the malignant, ulcerous sore throat, it must be acknowledged that they are productive of the best effects. But with deference to these great authorities, I think blisters should be applied with the utmost caution, in all cases, attended with an highly putrid, and dissolved state of the fluids: For under such circumstances, they often exhaust the strength of the patient, by exciting an immoderate discharge of bloody serum; and they sometimes occasion a sudden and fatal mortification.

3. IN the SMALL-POX, when the patient is of a lax and weak habit, when the pulse is low, feeble, and depressed; and the fever insufficient for the expulsion and suppuration

(u) Riverii Opera, p. 541.

(x) Etmuller. Op. p. 365.

of the pustules, epispastics are certainly indicated (y). When the pocks are of the bloody kind, and attended with delirium, Dr. Mead assures us that blisters may be used with equal safety and advantage. And in this distemper, whenever the maturation of the pustules does not regularly succeed their eruption, and when anxiety, inquietude, difficulty of breathing, and delirium come on, the fever should be quickened by warm cordial medicines, and especially by the application of blisters (z). This is confirmed by the testimony of Dr. Tissot, in a late publication, who, after pointing out the analogy between the action of opium and cantharides in the small-pox, says, *Unicum est symptoma in quo, dum hæc pulchra operantur, à narcoticis caveo; ubi nimirum relicta cute, ad pulmonem acre devolvit viru, cum frequentissimo, celerrimo, debiliq[ue] pulsu, cutis siccitate, orthopnœa, anxietate, delirio. Gravis est sanè casus, et è pessimis in medicina variolosa, quem feliciter aliquoties, citò accersitus, curavi, larga et accerima vesicatoria suris applicando, largissimos et calidos haustus decocti hordei, et sambuci melliti prescribendo, cum minimis dosibus sulphuris aurati antimonii. Quatuor vel quinque lapsis horis, remittit frequentia*

(y) Hillary on the Small-pox, p. 94, 95.

(z) Mead, Sydenham, Morton.

pulsus, recedit anxietas, madet cutis, increſcunt vires. Omnino liberato pectore, et demiffa febre, juvari poteſt natura leni narcotico. Diu fluere crura juvat(a). It is always accounted a bad ſymptom, when the ſwelling of the hands does not follow the tumour of the face, and the ſwelling of the feet that of the hands; and if the patient be threatened with this alarming circumſtance, epiſpaſtics ſhould be applied to the wrifts and ancles, a little before the inflammation of thoſe parts may be expected to begin. For they will not only tend to draw the humours thither, but will give them alſo a ſalutary vent(*b*). When the fauces are covered with puſtules, and both deglutition and reſpiration are impeded by the ſwelling of the throat, bliſters applied to the neck are highly ſerviceable, as I have frequently experienced. Dr. Tiffot relates the hiſtory of a patient, under theſe circumſtances, who was ſuddenly relieved by the application of ſinapiſms to the feet. *Vidi hoc anno collum horridè turgidum, eduſta è lecto ægra, et ſinapiſmis plantis pedum applicatis, intra viginti minuta, dimidiam diametri partem amiſſiſſe. Horrendos verum eſt pedum patiebatur dolores, quos per bihorium tolerare ſuaſi; tunc tumentibus admodum cruribus, ſinapi removi;*

(*a*) Tiffot. de variolis, &c. vid. Sandifort. Theſaur. vol. II. p. 11.

(*b*) Huxham, p. 155.

omnia pacabantur (c). In this instance, it is probable that blisters would have been no less efficacious than the sinapism; and they would have been more eligible, because productive of a less degree of pain and inflammation.

4. IN the APOPLEXY, whether arising from overdistended vessels, injuring the brain by pressure, from the effusion of blood within the *cranium*, or from a pituitous collection there; after attempting to relieve the head by bleeding, cupping the *occiput*, with deep scarifications, and using such other evacuations, as the state of the patient may require, blisters may be applied, both to the head and extremities, with great advantage. By increasing the circulation of the blood externally, and by producing a considerable discharge of serum, they will unload the vessels of the brain; whilst by their stimulus, they rouse the torpid system of nerves, excite the heart and arteries to quicker and more vigorous contractions, and thus powerfully contribute to restore the equilibrium between the *vis motrix*, and *moles movenda*.

5. IN the PALSY. When this disease invades the whole body, blisters are useful by their general stimulus. But they are most efficacious when the paralytic affection is not universal, but confined to some particular member or organ. Thus

(c) Sandisort. Thesaurus, vol. II. p. 16.

in palsies of the upper extremities, vesicatories applied to the *vertebræ* of the neck, and going obliquely to the shoulders, are remarkably useful. And when the disease attacks the lower extremities, they are equally efficacious, when laid upon the extremities themselves. As most of the nerves which go to the bladder, pass through the *foramina* of the *os sacrum*, vesicatories have been very successfully applied to that region, for the cure of an incontinence of urine. And it is probable, that they would be much more certain and powerful in their operation, if a proper attention were paid, in their external application, to the origin and course of the nerves (*d*).

6. IN the GUTTA SERENA, when it proceeds from a paralytic affection of the retina, blisters applied to the forepart of the head, so as to cover the nerves which issue through the *supra* orbital *foramina*, and spread themselves on the forehead, are highly serviceable, as I have more than once experienced.

7. IN the TYMPANITES, Celsus advises to make ulcers in several parts of the belly, and to keep them running. But we are furnished, by means of epispastics, with a much more effectual, as well as more humane remedy. Dr. Mead recommends their application in this disorder: And it is probable they may do service, both as stimulants

and antispasmodics, except when the case is complicated with a mortification of the bowels.

8. IN the RICKETS, Boerhaave recommends blisters, to stimulate the languid vessels, and resolve the mucous concretions.

9. IN SCHIRROUS TUMOURS of the conglobate glands of the neck, blisters applied to the head, or behind the ears, have a good effect. The finer parts of the cantharides, being absorbed by the lymphatics, are carried immediately to the obstructed glands, and by their stimulus tend to disperse those indolent swellings. A young lady, who had a hard, glandular tumour in her neck, which succeeded the small-pox, and had resisted very powerful applications, was lately cured of it by a blister behind the ear, which I directed on account of an inflammation in one of her eyes. If the tumour be seated in the inguinal glands, vesicatories should be applied to the thighs. In such cases I have laid blisters over the glands themselves, but without any beneficial effect.

10. IN those schirrous, or œdematous tumours of the joints, usually called WHITE SWELLINGS, which, after a tedious and ill conditioned suppuration, corrupt the *synovia*, shorten the tendons, make the bones carious, and destroy the articulation, blisters applied to the part affected, have
been

been sometimes highly serviceable (*f*). But their operation should be assisted by the internal use of the Peruvian bark, calomel, or other alterative and deobstruent medicines (*g*).

OTHER diseases, arising from the too weak action of the solids, might be enumerated; but what has been advanced will suffice to prove the efficacy and utility of blisters in such cases.

2. WHEN THE ACTION OF THE MOVING FIBRES IS IRREGULAR, vesicatories are indicated, both as stimulants and antispasmodics.

CONVULSIVE MOTIONS or SPASMS seem generally to arise from some peculiar irritation of the nervous system. And whether the brain be originally, or only sympathetically affected, whatever rouses and engages the attention of the mind will seldom fail to afford relief, by lessening, or destroying the sense of that irritation. Blisters therefore are indicated in such diseases, to stimulate and excite pain, in a part of the body that is sound. For according to the aphorism of Hippocrates, “When two pains occur, but not

(*f*) *Vide* Medical Transactions, vol. I. p. 104.

(*g*) THE Abbe Chappe mentions an epidemic disease in Russia, probably a species of the bronchocele, which the natives cure by the application of tobacco and sal ammoniac well masticated. The tumours are of the size of an apple, they rise suddenly, and if neglected soon become incurable. Travels into Siberia, p. 353.

in the same place, the greater obscures the less (*g*).” Dr. Whytt relates the case of a patient, who had an alternate motion of the muscles of the *abdomen*, which was cured by a circular blister, of about eight inches diameter, applied to the part affected (*b*). The same author acquaints us, that where epilepsies take their rise from an uneasy sensation in some part of the arm or leg, he has found vesicatories, applied to those parts, the most effectual remedies (*i*).

IN the convulsions which sometimes precede the eruption of the small-pox, blisters act as powerful antispasmodics. But they should not, upon slight occasions, be employed in this state of the disease, as by their stimulus they may aggravate the fever, and increase the number of pustules. When such symptoms occur in the ingrafted small-pox, as indicate the use of vesicatories, it is said that they will succeed the best, if applied to the arms, over the part where the variolous matter was inserted. This I am informed is the present practice of an ingenious physician, and celebrated inoculator, who merits all the honours which have been conferred upon him, by one of the wisest potentates in Europe.

(*g*) Lib. II. Aph. 46.

(*b*) Whytt on Nerv. Dis. p. 460.

(*i*) Whitt on Nerv. Dis. p. 461.

IN the idiopathic epilepsy, the application of vesicatories to the head is recommended by Hoffman, Riverius, Pifo, and Mead; who support their recommendation by many authentic cases and histories. Celsus mentions several remedies for the epilepsy, which are very singular; such as drinking the warm blood of a gladiator just slain, eating human or horse's flesh, or the parts of generation of certain animals. If these things ever had any efficacy, it must arise from the repugnancy of nature to them, and from the strong and painful sensations of mind, which such shocking and disgusting remedies could not fail to excite. Upon the same principle, Boerhaave cured the epileptics, in the poor house at Haerlem (*k*).

HOFFMAN relates that he has found epispastics of excellent use, in the spasmodic asthma (*l*); and Dr. Whytt confirms the testimony of Hoffman by his own experience (*m*).

IN fixed pains of the bowels, from spasms, though there are no evident marks of inflammation, the application of blisters to the *abdomen*

(*k*) See the Account in Kaw Boerhaave.

(*l*) Hoffman de Vesicant.

(*m*) Nerv. Dis. p. 495. Epispastics have also been found to be very serviceable in the *tussis convulsiva*.

Vide Ridley's Observ. p. 91.

may be recommended. Sir John Pringle assures us, that he has oftener than once seen a patient relieved in his bowels, as soon as he felt the burning of his skin; and at the same time have stools by a purge, or a clyster, which had not operated before. In severe, and continued vomitings, when the stomach is affected with very painful, convulsive motions, I have observed the most salutary effects, from the application of a vesicatory to the epigastric region. Hence we may conclude, that blisters act not, in such cases, as evacuants, but as antispasmodics.

3. WHEN THE ACTION OF THE SOLIDA VIVA IS TOO STRONG.

It is yet a subject of dispute amongst physicians, whether epispastics are useful, or detrimental, in inflammatory fevers. Hoffman bears the strongest testimony against their application in such cases (*n*); and Baglivi, from his own experience, asserts, *Quod delirantibus cum febre acuta, lingua arida, et indicijs magnæ viscerum inflammationis, si applicentur vesicantia, omnia in pejus ruunt, et magna ex parte moriuntur convulsi* (*o*). Alpinus says, *Nunquam probare potui, in acutis febribus, vesicantium usum, quod calorem febrilem augeant, vigilias doloremque conci-*

(*n*) De Vesicant. usu. § 17.

(*o*) Praxis, p. 102.

rent, et deliria inducant, coctionem impedian, non minus et motui humorum critico obsint, quum incertus sit locus ad quem, vel per quem crisis, est futura (q). Sir John Pringle acquaints us, that his first practice, in every inflammatory fever was to blister; but afterwards, when he found that a solution of the fever was not to be procured by such means, he confined the use of epispastics to those states of the disease, in which he could be most assured of their efficacy (*r*). Huxham, if I mistake not, observes, that to blister in the beginning of inflammatory fevers is to add fuel to the fire; and Dr Whytt expressly says, that in fevers, where there is no partial obstruction or inflammation, vesicatories are of little service, and are sometimes hurtful; unless perhaps towards the end of the disease, when the pulse begins to sink (*s*).

ON the other hand Sydenham, whose authority must have great weight, from his accurate atten-

(*q*) *Medicin. Method. lib. V. p. 173.*

(*r*) IN the second stage of the jail or hospital fever, when the pulse is quick and full, Sir John Pringle hath used blisters, but without success. Nay upon the first attack, the whole head has been blistered, and the oozing kept up for some days, without relieving it, or preventing any of the usual symptoms.

Dis. of the Army, p. 318.

(*s*) *Philos. Transf. vol. L. part II. p. 578.*

tion to the *juvantia* and *lædientia* in all diseases, adopted the use of blisters in the continued acute fever, which prevailed in the years 1673, 1674, 1675. The symptoms of this fever, as he describes them, indicate a very high degree of inflammation; and his practice was, first to take away a sufficient quantity of blood from the arm, and then to apply a large epispastic to the neck: At the same time he employed the cooling regimen. Dr. Freind says, that in acute fevers, the safest and most speedy relief is afforded by vesicatories. Nor are we to be too scrupulous about accommodating them to the constitution, or state of the patient; for whatever his habit of body may be, if the fever rages beyond measure, the slight inconvenience of a blister is rather to be endured, than the life of the patient endangered; for in these cases, the only hope is in blisters. They derive the febrile matter from the brain, and assist and promote the other discharges, those especially by sweat and urine (*s*). Dr. Glafs also, in his learned commentaries, recommends the application of blisters in inflammatory fevers. *In febris inflammatoriis, post debitam sanguinis missionem, locum habet id remedium; atque licet motus arteriarum, etiamnum nimis veloces, ab eo intenduntur, brevi tantum intervallo id fiet,*

(*s*) Vide Freind de Vesicant.

postea quidem, eliquatis densis humoribus, pulsus sentientur molliores, et febres erunt leniores (t). “I have more than once in an evening,” says Dr. Lind, in his valuable paper on fevers and infection, “ordered eight or ten patients to be blistered, and have left them with a quick pulse, great heat, immoderate thirst, a pain, confusion, and heaviness of the head, and what, to a physician conversant with such fevers, communicates a most certain knowledge of the condition of the patient, such a lifeless, sunk state of the eyes, as denoted great danger. But the next morning I found these patients with a lively, brisk eye, a calm pulse, and with a desire to get out of bed (u).” Other authorities to the same purpose might be advanced.

How then are we to determine this dispute? May not the truth in this, as in most other litigated points, lie in the middle way between the opposite opinions? If so, the following conclusion may perhaps be justified: that whenever the inflammatory *diathesis* prevails strongly and uniformly throughout the system, and no one part is more affected than the rest, vesicatories are pernicious and detrimental. But when peculiar symptoms of inflammation attack the head, the

(t) Glafs, Comment. p. 235.

(u) Lind on Fevers and Infection, p. 9.

lungs, &c. and prevail more in those parts, than the rest of the body, blisters are indicated, and often prove remarkably useful. And in such cases, they are found from experience to lessen the impetus of the blood upon the vessels of the inflamed part, to abate the fever and heat of the body, and to diminish, very evidently the quickness of the pulse (*x*). Whatever may have been the original cause of a fever, it will be continued, and often greatly increased, by any particular inflammation, which may happen to have taken rise from it. Under these circumstances, the application of a blister to a neighbouring part will sometimes produce a resolution of the disease, by lessening the impetus of the fluids on the inflamed part, by making a considerable derivation of ferous humours from it, and by rendering the
mind

(*x*) To understand more clearly the action of blisters in such cases, it is necessary to form a just idea of the nature of inflammation, which seems to consist in an increased alternate contraction of the vessels of the part affected. If the inflammation be large, or the part inflamed very sensible, the whole nervous system will be so affected by the pain, as to render the heart and larger arteries more irritable; and the force of the circulation will, of course, be greatly increased, through the whole body. This state is what is called the inflammatory *diathesis*. In the cure of inflammation therefore, two indications are to be attended to; 1. to diminish the force of the circulation in general; 2. to abate the
action

mind less sensible of the painful irritation, which excites and continues the inflammation. Upon these principles, I apprehend, we may easily explain the action, and deduce from them the uses of epispastics in the following diseases.

I. IN the SYMPTOMATIC PHRENITIS OR DELIRIUM, which accedes indifferently to the bilious, malignant, or inflammatory fever. If the lowness of the pulse admits not of venæsection, the cure must be attempted by leeches and blisters (*y*). On this subject, Dr. Whytt furnishes us with a practical observation of importance: that in fevers, where the substance of the brain is affected, and not its membranes, he has never found any benefit from the use of blisters. And he always suspects the brain to be affected, when a fever

action of the vessels in the part affected. The former is to be attempted by venæsection, and the antiphlogistic regimen; the latter by emollient and sedative applications, and frequently by blistering the neighbouring parts. For the impetus of the fluids, in the vessels of the part to which the vesicatory is applied, is much more augmented in proportion, than the force of the circulation in general. And as there seems to be only a certain degree of nervous energy, exerted in the body at one time, the increase of its action in one part, will necessarily diminish it in another. And thus the original inflammation is cured, by exciting another contiguous to it.

(*y*) *Vid.* Pringle on the Dis. of the Army, p. 138.

and delirium come on, without any preceding head-ach, or redness in the *tunica albuginea* of the eyes. This kind of fever he has met with several times, and has observed it to be generally fatal (z). But I have lately had under my care a patient, whose case furnishes an exception to this valuable observation; and as there is something in it singular and curious, it may not perhaps be an useless digression, to give a detail of the most interesting circumstances which attended it.

M. B. a maid servant, aged twenty-four, being with child, was turned out of her place, and obliged to go into the poor house, where she remained several weeks after her delivery. But sunk with low diet, oppressed with uneasiness, and exhausted with nursing, she was taken back by her friends, who were assisted in their endeavours to recruit and restore her strength, by the charitable benefactions of a neighbouring gentlewoman, distinguished for her humanity. August 12th, 1766, a few days after her return home, she was seized with a fever, which began with a coldness and shivering, and was succeeded by heat. On the 18th I saw her, and found her in a delirium, with a low and feeble pulse. Her eyes were sunk, but without the least redness or in-

(z) *Vid.* Phil. Trans. vol. L. part II. p. 578.

inflammation, nor had she complained of any preceding pain in the head. Her urine was sometimes pale, sometimes high coloured. Her skin had that kind of heat, which is not easily described, but which leaves a disagreeable sensation in the hand that feels it. Her tongue was dry and blackish; she had a flushing every now and then in her face, and her belly was immoderately loose; and to all these complaints an almost total deafness was added. In the afternoon, there was generally a slight remission of the symptoms.

A LARGE blister was ordered to be laid betwixt her shoulders, and a cordial, diaphoretic, and lightly astringent mixture was prescribed.

AUG. 20. The delirium ceased. Her pulse and heat were natural, her looseness was abated, but her deafness still continued. Two blisters were directed to be applied behind her ears.

21. THERE seemed to be no appearance of fever, and the deafness was going off, though the blisters had not been applied. She complained of a numbness in her right leg, which on examination I found to be cold and motionless. Directions were given to rub it well with the flesh brush, and a large cataplasm of mustard and oat meal *ana p. æ.* was ordered to be applied to her foot.

24. THE palsy was almost removed. In other respects she was well, except the pain occasioned by the cataplasm.

30th. SHE had the perfect use of her leg.

SEPTEMBER. 3d. Though the inflammation occasioned by the cataplasm was very inconsiderable, yet she complained of great pain arising from it. Her foot was therefore fomented with a decoction of camomile and poppy heads, to which a sufficient quantity of milk was added; and afterwards a white bread poultice was applied.

5th. THIS morning she was seized with convulsions of the epileptic kind, and had six fits successively. She was cold, feeble, and languid, and complained much of sickness and pain in her head. The following medicines were prescribed.

R. Tinct. valerian. volat. tinct. fuliginis, ana ʒss. laud. liquid. gutt. xl. m. cap. cochl. parv. ij. omni hora, ex cyatho aquæ spiritusque vini gallici.

R. Rad. valerian. sylvest. ʒss. aq. fontan. ʒxij. coque parum, et adde asafœtid. ʒiss. m. f. enema statim injiciend.

6th. SHE was better, and had no return of the fits; but complained still of violent pain in the foot.

7th. SHE continued free from the fits. Her head was easier, but her foot was still painful. Yesterday in the afternoon, she was suddenly deprived of her sight, without the least previous pain or uneasiness in her eyes. No inflammation,
opacity,

opacity, or alteration of any kind appeared externally; except that the pupils were more than ordinarily dilated. On holding a lighted candle close to her eye, the pupil did not contract itself, and she had not the least perception of the light. As I apprehended her blindness to be a *gutta serena*, arising from a paralytic affection of the retina, I ordered her forehead to be frequently rubbed with the *liniment. volatile*, made with equal quantities of *ol. oliv.* and *sp. salis ammon. cum calce viva*; and afterwards a flannel, moistened with the mixture, to be left upon the part. It was hoped that by this stimulus, applied immediately to the nerves which issue from the eyes, through the *supra-orbital foramina*, the retina might be restored to its proper sensibility. And the event in some measure answered my expectations; for before night, she was able to distinguish the light of a candle. But the recovery of her sight was both imperfect, and of short continuance.

8th. SHE was still blind, and more stupid and heavy than usual. She was frequently sick, and vomited her food, but refused all medicines. A blister was ordered to be applied to her forehead.

9th. SHE had perfectly recovered her sight. No sooner did the blister begin to operate, but she had a glimmering of light, the pain occasioned a flow of tears, and she was gradually, during

the action of the vesicatory, restored to the use of her eyes.

10th. SHE still retained the perfect use of her eyes; was more cheerful and lively, had no pain in her head, and complained less of her foot. As she seemed to be in a fair way of recovering her former state of health, I left her, after giving the proper directions with respect to her diet.

N. B. THE young woman continued to recover, and about ten days afterwards, I saw her perfectly well.

II. IN OPHTHALMIAS. Inflammations of the eyes are frequently cured, by making a derivation from the part affected, either by means of leeches, or of blisters. Perhaps both might be usefully applied at the same time; the leeches near the external angle of the eye, and the blisters behind the ears; or, according to the present more efficacious method of practice, upon the forepart of the head. To conspire with their operation, if the flux of humours to the eyes be great, a brisk purge may be administered, to make a revulsion. And thus, I apprehend, a cure may be completed, without draining the whole body by large and repeated venæsections. Hoffman dissuades us from applying epispastics to the neck, in ophthalmias. *In ophthalmia egregij sunt usus; sed observavi, quod in nucha non adeo conducant, sed*

sed potius dolor inde augeatur ; quam contrà pedibus admota, sæpe simulac humor stillare incipit, dolorem levent (a).

III. IN NASAL HÆMORRHAGES, blisters applied to the back have been serviceable (*b*) ; and may we not from analogy conclude, that they would be equally useful in HÆMOPTOES ?

IV. IN the INFLAMMATORY ANGINA, Sydenham recommends the application of a large and strong epispastic between the shoulders, having premised bleeding and purging. Sir John Pringle mentions another remedy, whose mode of operation seems to be similar to that of blisters ; viz. the application of a piece of flannel to the throat, moistened with two parts of *ol. oliv.* and one of *sp. c. c. vol.* or in such a proportion as the skin will bear. By this means the neck, and sometimes the whole body, is put into a sweat. But I imagine it is not by the *diaphoresis*, so much as by the revulsion which it produces, that this application is so efficacious : and upon this principle, perhaps a blister would be still more serviceable. Its operation indeed would not be so quick ; but the copious derivation of ferous humours, from vessels nearly connected with the

(a) De Vesicant. usu. § 12.

(b) Cullen's Clinical Lect.

inflamed parts, would much more than balance the comparative slowness of its operation (c).

V. IN the first stage of the ANGINA MALIGNA, a blister applied to the nape of the neck, or to each side of the throat, produces very salutary effects. But as the skin in this disease is particularly disposed to inflammation, I have seen inconveniences arise from the two powerful stimulus of the cantharides. Of late, therefore, I have directed the *emplast. vesicatorium*, of the London Dispensatory, to be mixed with an equal or double proportion of the *emplast. stomachicum*, and to this composition, have added a drachm or two of camphor, properly comminuted with rectified spirit of wine. Such a plaister I have repeatedly experienced to be sufficiently efficacious as a blister; and the antiseptic ingredients it contains, coincide with the general indication of correcting putrefaction.

IF a blister plaister, after being moderately warmed before the fire, be covered with a fine soft piece of muslin, it will occasion much less irritation; produce no strangury, or but in a slight

(c) On looking into the last edition of Sir John Pringle's Diseases of the Army, I find a note in which he informs us, that in later practice, besides a blister to the back, in bad cases he lays one across the throat: at other times he has applied seven or eight leeches under the *fauces*. p. 173.

degree

degree; and, when it is to be removed, will separate from the skin, with great facility: nor will such a covering prevent its vesicating effects. Hence blisters may, in this manner, be applied with advantage, whenever the skin is disposed to erysipelatous inflammation, from its extreme sensibility; or when their evacuating powers are wanted, with a diminution of their stimulus. In puerperal cases also, they may thus be used, without danger of inflaming the *uterus*, by their action on the urinary passages.

VI. IN a true PERIPNEUMONY, especially when the inflammation is great, repeated bleeding is the principal remedy; and Dr. Whytt dissuades us from the early application of blisters. But when the disease is of a mixed kind, when the lungs are not so much inflamed, as loaded with a pituitous matter, when bleeding gives but little relief, when the pulse though quick is small, when the patient is not able to bear evacuations, and the disease hath continued for some time, in such circumstances epispastics will produce remarkably good effects (*d*). Sir John Pringle says that a pleurisy, taken in the beginning, may often be cured by one large blèeding, and a blister laid to the side affected. If there be no particular stitch, but only a general oppression, the vesicatory

(*d*) Phil. Transf. vol. L. part. II.

may be applied to the back, and afterwards, if the disease be obstinate, first to one side, and then to the other. Whether applied to the chest, or to the extremities, it will relieve the breast, promote expectoration, and lower the pulse. In pulmonic disorders, Huxham recommends blistering the legs; and he observes that when they ulcerate the extremities severely, they commonly give great relief (*e*).

VII. IN the CHRONIC ASTHMA, when the patients strength is very much reduced, blisters are highly efficacious. But they should never be applied to the chest, when the *dyspnoea* is very severe; because they render the motion of the intercostal muscles more difficult and painful, as well as obstruct respiration, by their pressure and tenacity. In these cases volatiles are peculiarly useful.

VIII. IN the SMALL-POX, when it is attended with rawness, foreness, and great heat in the mouth and throat, and a sharp rheum or stoppage in the nostrils, blisters are found to be very successful. And in this disease, whenever the *membrana schneideriana* is affected, a revulsion from it is indicated; otherwise towards the close of it, the patient will be in danger of suffocation (*f*).

(*e*) *Vid.* Essay on Fevers, p. 219, and Obs. de Acre. et Morb. Epid. vol. II.

(*f*) *Vid.* Essay on Fevers, p. 219, and Obs. de Acre. et Morb. Epid. vol. II. p. 140, 149.

IX. IN COUGHS, attended with fever, pain in the side, and a pituitous infarction of the lungs, blisters are highly efficacious, in abating the fever, lowering the pulse, and removing the inflammatory obstruction. This Dr. Whytt hath satisfactorily proved, by a detail of cases, laid before the Royal Society, and published in the *Philos. Trans.* vol. L.

X. IN the INFLAMMATION OF THE LIVER, one of the best remedies is a large blister laid over the part affected (*g*).

XI. IN the INFLAMMATION of the STOMACH and INTESTINES, in the ILEUS and INFLAMMATORY COLIC, epispastics are found to be serviceable (*b*).

XII. IN the DYSENTERY, when the pains in the belly are too fixed to yield to fomentations, they are relieved by a blister, applied to the *abdomen* (*i*).

XIII. BLISTERS are remarkably serviceable in the DIARRHOEA, which sometimes attends the MEASLES; probably because they lessen the inflammation, which in this disease falls on the intestines.

XIV. IN the RHEUMATISM, SCIATICA, and GOUT, Hoffman commends the use of vesicatories, because they set in motion, and evacuate the

(*g*) Pringle's *Dis. of the Army*, p. 151.

(*b*) *Ibid*.

(*i*) Pringle's *Dis. of the Army*, p. 202.

supposed acrid matter, which is impacted in the nervous and tendinous parts. Pringle advises their application to the part affected, in the rheumatism and sciatica; and a celebrated Professor at Edinburgh asserts, that they seldom fail of success in the rheumatism, when applied before a swelling of the part comes on (*k*). Huxham also bears testimony in favour of epispastics: *In crudelissimo rheumatismo, nihil magis prodest quam vesicatoria, inter scapulas superimposita* (*l*).

THUS much for the action of blisters on the MOVING FIBRES. Their operation on the FLUIDS depends upon their medicinal powers, as attenuants and evacuants; and these, perhaps, arise solely from their stimulus on the solids. By quickening the alternative contractions of the vessels, they prevent the stagnation of the juices; hence their attenuating effects: and by exciting an inflammation externally, they occasion a flux of humours to the skin, and a consequent evacuation of them. It seems therefore to be almost unnecessary, to consider vesicatories as belonging to this second class of medicines. But as some interesting particulars, relating to their operation as evacuants, have been omitted in the preceding part of this attempt to investigate their uses, I shall briefly consider them under this head.

(*k*) Cullen's Clinical Lectures.

(*l*) De Colico Damnoniorum.

I. IN NERVOUS FEVERS, blisters act not only as a stimulus, but as a drain; and they should not be too soon dried up. Huxham says, the more they discharge, and the better it is for the patient: and when the first blisters heal up, he recommends the application of others.

II. IN DROPSIES, particularly in the *anasarca*, blisters applied to the legs produce a very copious discharge of serous humours; but they should be used with caution, because they sometimes occasion a spreading, painful, and dangerous inflammation. I was lately witness to a fatal case of this kind. The patient laboured under a dropsey of the *thorax*, and a general *anasarca*. His legs and thighs were swoln to an amazing size. Veficatories were applied to the extremities, a little above each ankle; and by unloading the cellular membrane, they at first afforded great relief; but in a few days an erysipelas ensued, which extended itself over the whole legs and part of the thighs, producing such excruciating pain, that the patient, whose strength had been before nearly exhausted, sunk under the anguish.—Whenever it is thought expedient to employ blisters, for the removal of anasarcaous swellings, they should be covered with fine, soft muslin, in the manner before described.

III. IN the LYMPHATIC OR CRYSTALLINE SMALL-POX, veficatories are recommended as evacuants, both

both by Huxham and Mead. For by the seasonable discharge of the serosities, the fever, which increases when there is no further derivation of humours to the skin, is happily moderated, if not prevented.

IV. IN the WARTY SMALL-POX, blisters are very useful evacuants; because the matter being too thick, can neither suppurate, nor pass off by urine (*m*).

V. IN the CONVULSIONS to which children are subject, the best practical writers advise the application of blisters, chiefly on account of the drain which they produce. The plenty of nutrition, which nature hath provided for the young animal, from the time of its birth, necessarily creates many redundancies, which in a healthy state, are carried off by the glands of the skin, by urine, or by stool. Hence when the infant is arrived to a certain growth, an eruption, called the red gum, usually appears on the surface of the body, and frequently at the same time, there is a discharge from the glands behind the ears, and in the groin. During these excretions, the child, for the most part, is lively and well; but as the equilibrium of health, in such delicate subjects, is easily disturbed, their continuance is very precarious. And if some new evacuation be not substituted in the room of them, disease will unavoidably ensue.

For so exquisite is the sensibility of the nervous system in children, that a very slight degree of irritation will, in their tender bodies, excite convulsions. In such circumstances, the utility of blisters is obvious, and might be inferred even *à priori*, if experience had not given a sanction to their application. But their good effects are warranted by the most undoubted testimonies. And as a proof, how salutary it is to promote the discharge of the superabundant juices in children, Willis relates the case of a girl, who was subject to the epilepsy, and in one of her fits fell into the fire, and burnt her face and forehead in the most shocking manner. The accident however was attended with this good effect, that as long as the ulcers remained open, she was free from the disorder. Hollerius furnishes us with a similar example. A girl had, from her infancy, a running sore in her head: It was suddenly healed, and she became epileptic. Variety of remedies were tried to no purpose: Duretus was consulted, who recommended the application of beet leaves to her head, which brought on a large discharge, and removed her epilepsy (*n*). Agreeable to this is the observation of Hippocrates, that running sores of the head, happening to children, prevent convulsions. *Quibus-*

(*n*) Boerhaave de Morb. Nerv. p. 320.

cunque quidem pueris existentibus, erumpunt ulcera in caput, et in aures, ac in reliquum corpus; et qui salivosi sunt, ac mucosi, hi ipsi in progressu ætatis facillimè degunt: Qui vero mundi sunt, et neque ulcus ullum, neque mucus, neque ulla saliva prodit, neque in uteris purgationem fecerunt, talibus periculum imminet, ut ab hoc morbo (i. e. epilepsia) corripiantur (o). Dr. Mead, in his learned treatise, *de imperio solis et lunæ*, furnishes us with a very remarkable history of the epilepsy, cured by a discharge from the head, in consequence of the application of a blister. A child about five years old, of a lusty and full habit of body, had convulsions so strong and frequent, that her life was with difficulty saved by evacuants, and other medicines. She continued well for a few days, but was, at the full of the moon, again attacked with a most violent fit; after which the disease regularly kept the same period with the tides. She continued in this state fourteen days, that is, till the next great change of the moon, when a dry scab, the effect of an epispastic with which the whole *occiput* had been covered, broke out, and from the sore issued a considerable quantity of limpid serum. This discharge was promoted by proper applications; and the patient grew up to woman's estate, without ever suffering any return

(o) Hippoc. de Morb. Sacro.

of the dreadful disease, under which she had laboured. Celsus, in the epilepsy, recommends scarification, and the application of cupping glasses to the *occiput* (*p*); and as this disease frequently arises, especially in children, from plenitude, and a redundancy of humours in the head, a drain made from that part, may justly be regarded as a probable means of cure.

(*p*) Lib. III. cap. 23.

E S S A Y *
A N
I N Q U I R Y
I N T O T H E R E S E M B L A N C E B E T W E E N
C H Y L E A N D M I L K.

— *Probabilia conjecturâ sequens.*

Cic. Tusc. lib. I.

TH E properties of milk have with great ingenuity been investigated, and with equal precision ascertained, by several medical writers ; and if the nature of the chyle were as well known, the subject of the present inquiry would be obvious, and of easy solution. But as this fluid cannot, without great difficulty, be collected in sufficient quantity to undergo an experimental examination, it is almost impossible to determine its qualities, with any considerable degree of certainty. Nor have I, in a great variety of authors which I have consulted, met with one experiment, which has been made

* T H I S Essay was read to the Royal Medical Society of Edinburgh in the year 1763.

immediately

immediately on the chyle, taken from the lacteal vessels. We must therefore content ourselves with attempting to determine, *à priori*, its nature and properties; that by comparing these with the known qualities of milk, some probable conclusions at least may be deduced. And these conclusions may be confirmed by other arguments, drawn from facts and observations.

I. THE chyle must necessarily be composed of the food we eat; which, being masticated in the mouth, and mixed with the fermentable saliva, is carried into the stomach, where it receives the addition of the *succus gastricus*, is further broken down, ferments, and passes over the *pylorus* into the *duodenum*. Here it mixes with the bile, cystic and hepatic, with the *succus pancreaticus*, and the lymph which is thrown out from the exhalant arteries, into the intestines. At length, if the animal feed chiefly upon vegetables, it is changed into a white and saccharine fluid, which being imbibed by the lacteals, is carried into the course of circulation, to be further assimilated, animalized, and converted *in succum et sanguinem*.

THE fluid thus formed, in all probability, consists of oil, mucilage, water, a coagulable part, and fixed air. That oil and mucilage enter into its composition, may be presumed from the whiteness of its colour; for these two substances, when intimately combined with water, always

put on that appearance. The existence of a coagulable part in the chyle is rather more uncertain; but I think there is some foundation for the hypothesis. Our food is mixed, in the *primæ viæ*, with a considerable quantity of lymph, which, as it is composed of the serum of the blood, must be of a coagulable nature. And the mucus, contained in the aliment itself, possesses also in some degree the same property. So that we may with probability conclude, that the chyle is not destitute of a coagulable part. This coagulable part of the chyle may possibly owe its origin, as much to the peculiar process of fermentation, which takes place in the *primæ viæ*, as to the animal fluids which are mixed with our food, in its passage through the stomach and small intestines. And this fermentation depends, in a great measure, on the nature of the aliments ingested. For it is observed that a cow, which feeds upon rank and watery grass, yields milk that contains very little *crassamentum*, and is therefore unfit for the purpose of making cheese. That fixed air enters into its composition is acknowledged by every one, and has lately been very ingeniously illustrated, by the experiments of Dr. Macbride.

BOERHAAVE, and other chemical writers endeavour to explain the formation of chyle, by the instance of an emulsion, which is made by triturating

curating any of the oleaginous vegetables with water. But the analogy between them is very imperfect, and perhaps only subsists in this single particular, that the white colour of each fluid arises from the mixture of oil and water, by the intervention of mucilage.

II. MILK consists of oil, mucilage, sugar, water, and air. The oil is obtained by a spontaneous separation, and is called cream. The mucilage is that coagulable part, of which cheese is made. It has often been compared to the serum of the blood; but differs from it in this essential particular, that it is not coagulated by heat. The water contains a quantity of sugar, which may be separated from it, by evaporating with a gentle heat, and crystallizing. That air is present in milk may be made evident to the senses, by placing a quantity of it, previously heated, under the receiver of an air pump.

THE bare enumeration of the above particulars is sufficient to shew the similitude that subsists between the two animal fluids, which form the subject of our present inquiry. And if it could be satisfactorily ascertained, that the properties, and component parts of the chyle are justly laid down, this exact resemblance would prove, beyond all doubt, that they are one and the same. But, unfortunately, it cannot; and as my conclusion is founded upon hypothesis alone,

it is necessary to support it by arguments, drawn from facts and observations.

I. MILK, as to its properties, depends upon the aliment. *Pro vi et differentiâ assumptorum lac diversum esse; ex illis enim chylus melior vel deterior, dulcis vel amarus, ex hoc tale lac; qualia enim ingesta, talis chylus, qualis chylus, tale lac, assertum quotidiana confirmat experientia (a).* Dioscorides relates, that the milk of goats, which fed on the scammony plant and spurges, proved cathartic; and instances have been known, of an animal yielding bitter milk, from having eaten wormwood (*b*). If a nurse take a purgative, the infant will be purged; if she drink wine or spirituous liquors, it will be intoxicated (*c*); and I have been informed, from good authority, of one instance, where the eating of cabbage, or other flatulent vegetables, always gave the child the windy gripes. Milk, and the butter made from it, are found to differ greatly in colour, consistence, taste, and smell, according to the food of the animal. Human milk is made yellow by taking saffron, bitter by wormwood, and impregnated with a garlic smell by eating that root (*d*). Boerhaave relates that thick ale, taken by a fasting nurse, hath in a short space of

(a) Crantz M. M. p. 80.

(b) Vid. Lewis's Mat. Med. p. 330.

(c) Vid. Boerhaav. Prælect. § 690.

(d) Vid. Neumann's Chemistry, p. 569. Notes.

time been discharged through the breasts (*e*). These instances shew, that milk retains all the adventitious properties of the chyle; we may therefore conclude, by analogy, that the natural and peculiar qualities of that fluid remain also unchanged.

II. THE milk is proportioned in quantity, to the quantity of chyle. If the animal fast for a long space of time, neither chyle, nor milk is generated. The milk, which is secreted immediately after taking in food, is found to be crude and indigested; because it proceeds probably from the juices of the aliment, which are carried into the system by the absorbent vessels, before the chylous fermentation, if that expression be allowable, is perfected. A nurse yields the best milk about four hours after a meal; for by that time, the process of digestion is fully completed. In about eight hours, the chyle begins to be assimilated to the nature of the animal fluids, and then the milk assumes a yellowish colour, and acquires an offensive taste and smell. At length, when the chyle is converted into blood, the secretion from the breast no longer bears any resemblance to milk, but becomes acrid, fetid, and in every respect the reverse of that mild, sweet, and agreeable fluid.

(*e*) Prælect. § 688.

III. THE saccharine substance, that may be obtained from milk by inspissation and crystallization, and the inflammable spirit, procurable by fermentation and distillation, together with its acescent quality, in which it differs from all the other animal fluids, shew that the vegetable nature of the chyle is unaltered in the vessels of the breast(*f*).

IV. THAT the chyle may pass through the course of circulation, without immediately mixing with the animal fluids, appears from the example of water, which is sometimes secreted by the kidneys of hysterical persons, perfectly pure and insipid. And that it really does is evident from venæsection: For the chyle hath been seen floating on blood, recently drawn from the arm. In the last stage of a diabetes, the urine manifestly points out the presence of chyle in it, by its white colour, saccharine taste, and acescency. If it be kept in a close vessel seven or eight days, it will become sour, and ferment strongly with any of the mild alkaline salts. The learned Baron Van Swieten says, that a milky discharge hath been observed in diarrhœas(*g*).

(*f*) IF an animal feed upon vegetable diet, the milk will be saccharine and acescent; if upon animal, no sugar will appear in that fluid, but on the contrary it will be putrescent. *Vide* Young, Dissert. Inaug. Cap. viii. p. 55.

(*g*) Van Swieten Comment. § 1329.

And

And Mr. Patch, in the Edinburgh Medical Essays, relates the case of a boy, from whose groin issued, through a small and almost imperceptible orifice, four or five pints of a liquor like milk (*b*).

V. THE remarkable laxity of the vessels of the breasts, aided by the power of suction, in diminishing the resistance which the fluids might meet with in their passage through them, renders it probable, that the chyle may easily pass into the breasts, and be secreted there unchanged.

VI. BUT the following history, which fell under the inspection of a very celebrated physician (*i*), and was communicated to me by his friend and correspondent (*k*), puts the matter almost beyond dispute. I shall therefore conclude this inquiry with the detail of it. A girl, about eight years old, was tapped for an *ascites*. She had also an universal *anasarca*; and even her face was very much bloated, and exceedingly pale. Four quarts of liquor were drawn off, which was of a milky colour, full as white as milk mixed with an equal quantity of water. It would not coagulate by heat; but after standing a day or two, it was covered with a kind of thin cream, and in a few days more, it smelled, and tasted sour. The girl

(*b*) Edin. Med. Essays, vol. V.

(*i*) Dr. Huxham.

(*k*) Sir William Watson, M. D.

was greatly relieved by this evacuation; but the tumour of her belly soon increased again to such a degree, that it was necessary to renew the operation. A liquor the same as before, only somewhat more dilute, was drawn off, the swelling of her whole body subsided, and she recovered her appetite and strength. This girl, before she was attacked with these complaints, was very lively and active, and had a great appetite, in which she was too much indulged. Probably, by using violent exercise after a full meal, she had ruptured some of the lacteals.

E S S A Y VI.

EXPERIMENTS AND OBSERVATIONS ON

W A T E R :

PARTICULARLY ON THE HARD PUMP WATER OF

M A N C H E S T E R.

*Sapientis medici est, eorum locorum aquas ubi medicinam facit,
convenienti examine probè scrutari, quò postea cum fructu,
tam præservandi quam sanandi gratia, iis uti possit.*

HOFFMAN.

I N T R O D U C T I O N.

THE extensive influence of WATER on the health of mankind will, it is hoped, appear sufficiently evident, from the following Essay. The author proposed to have enlarged the subject of it, by inquiring into the effects of hard and soft water on a variety of the common arts of life, such as brewing, malting, dying, bleaching, tanning, &c. &c. But he found the subject too copious,

copious, to be reduced within the bounds which he had prescribed to himself; and that the prosecution of it, would too much abstract his attention from those favourite studies, which more immediately belong to his profession.

AN analysis of the waters, which are the objects of this inquiry, by means of evaporation, crystallization, &c. might perhaps have ascertained their contents with more minute exactness. But even this method is attended with some disadvantages; because heat decomposes many saline bodies; and to determine the composition of the *residuum*, recourse must have been had to the same chemical tests, which the author employed in his experiments. And it would have been an almost endless trouble, thus to analyze thirty different pump waters.

THIS Essay was intended only for communication to the ROYAL SOCIETY; and many of the experiments contained in it, have been read before that learned body. But the importance of the subject, and a desire of rendering his little work more extensively useful, have induced the author to publish it. And he flatters himself, that he shall at least be justified by the motives, if not by the success of his undertaking.

MANCHESTER, NOV. 1, 1771.

S E C T I O N I.

IT is a maxim of the divine Hippocrates, that whoever would apply with success to the study of physic, should acquaint himself with every circumstance relating to the situation of the place wherein he practises, the nature of the seasons, the influence of the winds, and the particular qualities of the water. The last object is by far the most important; because as a fixed and permanent cause, its effects will be regular, uniform, and constant. For whether the simple element itself be used, or it be mixed with vinous liquors, or brewed into beer, it will still retain in some measure its peculiar properties, and if impure, will gradually produce some morbid changes in the body. On the robust indeed, its action may perhaps be slow and imperceptible; but the tender and valetudinary will find themselves sooner and more sensibly affected by it. Many of the diseases of children, it is more than probable, owe their rise to this necessary diluent and vehicle of their food. And if we consider that numberless chronic disorders have their foundation
laid

laid in the state of infancy and childhood, the influence of water on the health of mankind will appear to be very extensive, and deserving of our strictest attention and regard. It would be no difficult matter to prove that a considerable number of those distempers, which, from their being peculiar to certain people and places, are termed endemic, are chiefly the effects of this powerful and active cause. Thus the inhabitants of the Alps, the Pyrenees, and of many other mountainous countries, are subject to a monstrous, external swelling of the glands of the neck, owing, as it is universally acknowledged, to the peculiar properties of the water they drink (*a*). “As you advance towards Mount Cenis,” says Mr. Sharp in his excellent Letters from Italy, “you find very few exempt from these tumours, which are so enormous, and of so loathsome an appearance, especially in ugly, ragged, half-starved old women, that the very sight of them turns the stomach. I was curious in my examination, whether any children are born with this malady upon them: I was informed that there is no such instance; and even that the swelling never begins to form till towards two years of age; some examples of which I myself saw (*b*)”.

(*a*) Quis tumidum guttur miratur in Alpibus?

Juvenal. Sat. 13.

(*b*) Sharp's Letters, p. 298.

Nor is this distemper peculiar to the natives of those countries; for strangers become affected with it, after residing there a few years (*c*). And such is the influence of custom on the common people, that they regard this blemish as a beauty, and even ridicule those who are without it. At Rheims, the capital of the province of Champagne in France, there is hardly an aged person free from the *bronchocele*, owing to the drinking, till of late, the common water of their wells, which runs through a kind of chalky quarry, with which it is strongly charged. The same effect has been observed to arise from the abuse of sea water (*d*). The inhabitants of the village of Steinfelfein, in the district of Schmiderberg, are said to have freed themselves from this malady, by abstaining from certain fountains, which were observed to produce it (*e*). In two cities of Hercynia, Wildeman and Andreasberg, which are built upon a large bed of minerals, scarcely a woman is to be found, who does not labour under strumous swellings of the throat, occasioned, it is justly supposed, by the constant use of hard, metallic, and calcareous water (*f*). The men

(*c*) Hoffman. Op. tom. VI. p. 202.

(*d*) Vide Lucas on Waters, vol. I. p. 29.

(*e*) Hoffman. Op. tom. VI. p. 203.

(*f*) Id.

too, in all probability, are not exempt from them; but as the female part of our species have more delicate constitutions, and especially a much greater degree of laxity in their glandular systems, the same causes, which but slightly affect the one sex, may prove highly injurious to the other. The people of Siberia, who live near the river Kirenga, which is remarkable for its impurity, are almost universally affected with scrophulous disorders; and strumous swellings are common, even amongst the cattle of that country (*g*). It is worthy of observation, that horses, by an instinctive sagacity, always prefer soft water, to that which is hard. And when, by necessity or inattention, they are confined to the latter, their coats become rough, and they are subject to the gripes.

HIPPOCRATES asserts, that hard waters, which are unfit for boiling, dry and astringe the belly; and that such as are stagnant and ill-scented injure both the belly and spleen (*b*). In confirmation of this it may be observed, that in Minorca, where the water, which the springs and rivulets afford, is often brackish, and always hard, obstructions, indurations, and swellings of the abdominal viscera, together with flatulency

(*g*) Comment. Lips. tom. II. p. 103.

(*b*) Hippoc. de Aere, Aquis, et Locis.

and indigestion, are the most common diseases to which the inhabitants are subject. And it is remarkable, that large spleens and tumefied livers are not peculiar there to the human species, but are incident also to brutes; especially to the sheep, which feed on the eastern side of the island, where the waters are particularly brackish (*i*). This shews the wisdom of the ancients, in examining the livers of the cattle, which they offered in sacrifice, wherever they proposed to build a town, or to pitch a camp. If they proved to be firm and sound, there they planned settlements, and erected fortifications. But on the contrary, if the livers appeared to be lax in their texture, or in any respect diseased, they speedily decamped; justly concluding, that the same food and water would produce a similar effect in human bodies (*k*).

PLINY mentions a fountain in Æthiopia, about which a large quantity of native cinnabar was found, and which produced its deleterious effects chiefly on the brain (*l*). And Athenæus speaks of a spring in Paphlagonia, to which the inhabitants of the country frequently resorted, which had an inebriating quality. Ovid poetically describes such waters, in the following lines.

(*i*) *Vide* Cleghorn on the Dis. of Minorca.

(*k*) Vitruvius, lib. I. cap. 4.

(*l*) Plin. Hist. lib. XXXI. c. 2.

*Cui non audita est obscenæ Salmacis undæ,
 Æthiopesque lacus? quos si quis faucibus hausit,
 Aut furit, aut patitur mirum gravitate soporem.*

Metamorph. lib. XV.

THE *Plica Polonica*, a singular disease to which the inhabitants of Poland and Lithuania are subject, and which consists in a præternatural enlargement and convolution of the hair, is in part ascribed by a very celebrated writer, to the use of impure water. *Morbi hujus causa valde perplexa & difficilis videtur, nihilominus eam, quantum fieri poterit, indagare allaborabimus. Primo multum sordidum vitæ genus confert, cui hi populi addicti sunt; dum raro crines pectunt, in humidis et depressis locis dormiunt, et spiritum vini liberalissimè ingurgitant. Suum quoque symbolum AQUÆ contribuunt; hinc non male Gebema in Epistola ad Bontekoe, de Plica Polonica pag. 10. sentit, hæere vitium in nonnullis Poloniæ aquis, &c.*

—— Nos supponimus quoddam vitium hæreditarium, quod in nimia pororum et bulborum capillorum sub cute in capite consistit; unde succus nutritius, crassus, et glutinosus, pravâ diætâ ex CRUDIS AQUIS productus, calore, quem potus spiritus vini conciliat, urgetur ad tubulos capillorum, ex quorum poris exsudat, et monstrosam illam intricationem efficit (m).—This supposition of the learned Hoff-

man is confirmed by the following aphorism of Sanctorius. Heavy water and a foggy air convert the matter of perspiration into an ichor, which, when retained in the body, induces a cachexy (*n*).

DR. MEAD, in the first edition of his Essay on Poisons, relates the case of a lady, whose life was formerly embittered by the frequent returns of violent colic pains, till she was happily advised by her physician, not to drink, as she usually did, beer brewed with well water. And so evidently was the establishment of her health owing to this caution, that the neglect of it was always attended with a return of her disorder. A fact similar to this is recorded by Van Helmont, of the monks belonging to a certain monastery near Brussels, who were always affected with the gripes, by the water which they used, unless they corrected its effects, by boiling wild carrot feeds in their beer (*o*).

THE *Elephantiasis* is endemial amongst the Egyptians (*p*), and is ascribed by Galen and Avicena to the use of the impure waters of the Nile. Lucretius also adopted the same opinion, as appears by the following lines :

(*n*) Sanctor. Med. Stat. sect. 2. Aph. 6.

(*o*) Helmont Lithiasis. — *Vide* also Hale's Stat. Essays, vol. II. p. 248.

(*p*) Alpinus de Med. Ægypt. Lib. I. cap. 4.

*Est Elephas Morbus, qui propter
flumina Nili*

Gignitur Ægypto in medio. ———

IT is an opinion which the father of physic first advanced, and which has been almost universally adopted by his followers, and hath remained till lately uncontroverted, that the stone and gravel are generated by the use of hard water. *Damnantur imprimis fontes*, says Pliny, *quorum Aquæ decoctæ, crassis obducunt vasa crustis* (q). And from this quality, which the waters of certain springs possess, of depositing a large earthy sediment, either in the aquæducts through which they are conveyed, or in the vessels in which they are boiled or preserved, it was obvious to infer, that in passing through the kidneys, and especially whilst retained in the bladder, they would let fall their grosser particles, which by the continued apposition of fresh matter, connected by the animal gluten, and compacted by the muscular action of that organ, would in time form a *Calculus*, sufficiently large to produce a train of the most excruciating symptoms. And this reasoning, *à priori*, has been supposed to be confirmed by facts and experience; for not to mention the authority of Hippocrates, Dr. Lister has observed, that the inhabitants of Paris, are

(q) Lib. XXXI. c. 3.

peculiarly subject to the stone in the bladder (*r*). And it is well known, that the water of the river Seine, with which that city is supplied, is so impregnated with calcareous matter, as to incrustate, and in a short time to choak up the pipes through which it runs. But on the other hand, it is objected, that the human *Calculus* is of animal origin, and by chemical analysis, appears to bear very little analogy to the stony concretions of water. And though it is allowed, that more persons are cut for the stone in the hospitals at Paris, than in most other places, yet upon enquiry it is found, that many of those patients come from different provinces, and from towns and villages far distant from the Seine.

I WILL not presume to decide this disputed point: but if I may be allowed to indulge a conjecture, I should suppose, that though this disease may chiefly depend upon a peculiar disposition to concrete in the animal fluids, which in many instances is hereditary, and in no instance can with certainty be imputed to any particular

(*r*) *Vid.* Liller's Journey to Paris.

NICHOLAS DE BLEGNY has related the history of one who was dissected at Paris, in whom the Pylorus, a great part of the Duodenum, and the stomach itself, were found incrustated with a stony matter, to the thickness of a finger's breadth. *Zodiac. Med. Gallic.* A. D. 1679. Mens. Feb. Obs. 3.

cause; yet hard water is at least negatively favourable to this *diathesis*, by having no tendency to diminish it. The urine of the most healthy person is generally loaded with terreous matter, capable, in favourable circumstances, of forming a *Calculus*; as is evident from the thick crust which it deposits on the sides of the vessels, in which it is contained. And it seems as if nature intended, by this excretion, to discharge all the superfluous salts of the blood, together with those earthy particles, which are either derived from our aliment, and fine enough to pass through the lacteals, though insuperable by the powers of circulation, or which arise from the abrasion of the solids, or from the dissolution of the red globular part of our fluids. Now water, whether used as nature presents us with it, or mixed with wine, or taken under the form of beer or ale, is the great diluter, vehicle, and *menstruum* both of our food, and of the saline, earthy, and recrementitious parts of the animal juices. And it is more or less adapted to the performance of these offices, in proportion to its degree of purity. For it must appear evident to the most ordinary understanding, that a *menstruum* already loaded, and perhaps saturated, with different contents, cannot act so powerfully as one which is free from all sensible impregnation. Nor is this reasoning
founded

founded upon theory alone (*s*): For it is observed, that MALVERN WATER, which issues from a spring, in Worcestershire, remarkable for its uncommon purity, hath the property of dissolving the little fabulous stones, which are often voided in nephritic complaints. And the solution too, which is a proof of its being complete, is perfectly colourless. Hence this water is drunk with great advantage, in disorders of the urinary passages. And during the use of it, the patient's urine is generally limpid, and seldom deposits any sandy sediment. Yet, notwithstanding this appearance of transparency, it is certainly at such times loaded with impurities, which are so diluted and dissolved as not to be visible. For it is attended with a strong and foetid smell, exactly resembling

(*s*) A GENTLEMAN of this place, who had been long subject to nephritic complaints, and often voided small stones, was advised to refrain from his own pump water, which is uncommonly hard, and to drink constantly the softer water of a neighbouring spring. And this change alone, without the use of any medicine, hath rendered the returns of his disorder much less frequent and painful. A lady also, much affected with the gravel, was induced, by the perusal of the first edition of this essay, to try the effect of soft water; and by the constant use of it, she has remained two years, entirely free from her disorder.

that

that of asparagus (*t*). Hoffman mentions a pure, light, simple water, in the principality of Henneberg in Germany, which is remarkable for its efficacy in the stone and gravel; and a water, of similar virtues, was discovered not many years ago, in the black forest near Osterod, which upon examination did not afford a single grain of mineral matter. Indeed it is worthy of observation, that most of the springs, which were formerly held in great esteem, and were called *holy wells*, are very pure, and yield little or no sediment.

THESE remarks are sufficient to shew the utility and importance of the following chemical inquiry into the nature and properties of the PUMP WATER of MANCHESTER. I therefore proceed to lay before the reader the most interesting of my

(*t*) *Vid.* Dr. Wall on Malvern Water.

IN nephritic cases, distilled water would be an excellent substitute for Malvern water, as the following experiment evinces.

Two fragments of the same Calculus, nearly of equal weights, were immersed, the one in three ounces of distilled water, the other in three ounces of hard pump water. The phials were hung up close together, in a kitchen chimney, at a convenient distance from the fire. After fourteen days maceration, the calculi were taken out, and carefully dried by a very gentle heat. The former, viz. that which had been immersed in distilled water, was diminished in its weight a grain and half; the latter had lost only half a grain.

experiments

experiments on this subject, with such inferences as are obviously deducible from them.

EXPERIMENT I. Near thirty different pump waters, most of them collected from pumps common to a whole neighbourhood, were chemically examined. They all curdled soap; the volatile alkali occasioned a precipitation in many of them; the fixed alkali in all of them; and they became quite milky with a solution of *saccharum saturni*. The infusion of galls produced no change in their colour; but syrup of violets turned most of them green.

EXPERIMENT II. A three ounce phial, after being carefully counterpoised in a very nice balance, was filled to the brim with distilled pump water, which weighed twenty-one drachms and fifty grains. The same phial, exactly balanced as before, was then filled to the brim with my own pump water, of the same temperature with the distilled water, which weighed twenty-one drachms and fifty-six grains (*u*). Several other pump waters were examined in the same way, and very little difference was found in their specific gravities. The water of a pump, belonging to a public brewery in this place, weighed indeed, in the quantity above-mentioned, only twenty-

(*u*) THIS experiment was afterwards tried by the hydrostatical balance, with no other difference in the result, but a small fraction of a grain.

one drachms and fifty-three grains. But on inquiry, I learned that this water is contained in a reservoir, supplied by means of pipes, either from the rain which falls in the neighbouring grounds, or from the superficial springs which run through them.

FROM the foregoing experiments it is obvious, that the pump water of Manchester is, in general, very impure. It is impregnated with a large quantity of felenite; an earthy astringent salt, composed of the vitriolic, nitrous, or marine acid, and calcareous earth; and at the same time contains no inconsiderable portion of alum, as may be reasonably inferred, from the green colour which it strikes with syrup of violets. For though it be acknowledged that Buxton, Bristol, Pyrmont, Spa, and other springs, which are not aluminous, produce a similar effect, yet these are all impregnated with mineral alkali, or with other substances, of which the Manchester pump water appears to be destitute, by the chemical tests employed in its examination(x). But what puts this conclusion beyond dispute is, that the earth of alum is frequently

(x) DR. LEWIS asserts in his *Materia Medica*, p. 71, “ that the blue juices of vegetables are changed red by
“ alum;” and again, in his excellent notes on Neumann’s Chemistry, p. 252, “ that syrup of violets is changed red by waters impregnated with alum.”

frequently found in the wells of this town. I have now in my possession some of this earth, which

The fact was otherwise in my trials; for two grains of alum, dissolved in an ounce of distilled water, struck a pea green with twenty drops of the same syrup of violets, which was used in the above recited experiments. A tea-spoonful of lime water, added to a part of the solution, considerably deepened the green colour; whereas two drops of elixir of vitriol produced, in the other part, a sensible though faint redness. A solution of alum also, in lime water, was turned at once into a deep green, by the addition of a small portion of syrup of violets. The lime water was added, in the first experiment, to render the water employed more analogous to the hard, calcareous pump water of Manchester.

IN a later trial I have found that the blue or purple juice of radishes is changed to a red, so slight however as barely to be perceptible, by a solution of alum in water. But this does not invalidate my conclusion, that many of the pump waters of Manchester are aluminous, because they are turned green by an admixture of syrup of violets. For it appears that a solution of alum produced a green colour in the same syrup of violets, which was employed in the before-mentioned experiment. And to secure against all fallacy, I repeated that experiment several times: Nor had I reason to suspect the genuineness of the syrup, as it was prepared at the Apothecary's Hall, and never failed to become red on the addition of an acid. The result of it is also corroborated by the testimony of Neumann, who asserts that the common sorts of alum change the syrup of violets green. Dr. Ruttty says that syrup of violets, when new, is turned red, but when kept some time green, by alum.

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by the addition of oil of vitriol, has been converted into true alum.—From the second experiment it is evident, that a quart of water contains upwards of sixty grains of adventitious matter; and supposing this quantity to be daily consumed, in one way or other, by every individual, which is a moderate computation, about forty-six ounces, troy weight, of crude, earthy, indigestible, and by no means inactive salts will, in the course of twelve months, be received into the body. And how pernicious this may be to health those can best conceive, who know the powerful influence of slight, but continued causes on the human frame. It would be foreign to my present purpose, to enter into a detail of the endemic diseases of Manchester. But one observation I cannot omit, that the inhabitants of this place are peculiarly subject to glandular obstructions, and scrophulous swellings. And that water, loaded with astringent, earthy salts, hath a direct tendency to produce such complaints, has been already, I hope, fully evinced.

BUT hard and impure water may be considered, in a further view, as injurious to the human body. It was before observed, that this universal *menstruum* is designed by nature to be the diluter, vehicle, and solvent both of our food, and of the recrementitious parts of the animal fluids. And
in

in the performance of these salutary offices, it immediately promotes the general health of the body, and at the same time counteracts the influence of various causes of disease. The Spaniards, it is said, are for the most part exempt from the itch and the scurvy, notwithstanding they indulge themselves in the daily use of pork, the least perspirable of all foods. And the reason assigned for this remarkable fact is, that the air of Spain is clear, thin, and serene, and the water light, pure, and wholesome (2). Hence the minutest series of vessels are continued permeable and unobstructed, perspiration is free and copious, all the excretions are duly and regularly performed, and every thing putrid and acrimonious is carried out of the system, before it has time to create disturbance or disorder. But water, impregnated with austere, earthy, and indigestible salts, is ill qualified to answer these important

(2) *Vid.* Hoffmani Opera, Tom. VI. p. 204.

HERODOTUS, whose testimony is not always to be depended upon, relates that in Æthiopia the inhabitants live to be an hundred and twenty years old, that they eat flesh, and drink milk; that the water of the country is so light, that nothing will float upon it, not even wood, and that the use of this water makes them long lived. Lib. III. c. 125.

ends. Already nearly saturated with its heterogeneous contents, it is rendered less capable of dissolving our food, of mingling uniformly with our fluids, or penetrating the finest ramifications of the vascular system, and of passing off copiously and easily by the several emunctories. And thus it becomes negatively the cause of diseases.

It is therefore of the utmost consequence, where nature hath denied the benefit of pure water, to discover some means of correcting its pernicious qualities. And with this view, the following experiments were made.

EXPERIMENT III. A strong solution of *sal tartari* was instilled into hard pump water, till no lactescency ensued. The same experiment was repeated with a smaller quantity of salt of tartar, so as not to destroy the insipidity of the water; but the softening effect of the vegetable alkali was then scarcely perceptible. Hence it appears, that the Manchester pump waters are too hard to be much improved in this way, without rendering them offensive to the palate.

EXPERIMENT IV. To half an ounce of hard pump water, just boiled, were added five drops of a solution of *saccharum saturni*. To an equal quantity of the same water unboiled, were also added five drops. The boiled became much less milky than the cold water. But supposing this effect to arise from the heat of the water, I poured
half

half an ounce of it into a glass, and when cold, instilled five drops of the solution of sugar of lead into it, as before, without any increase of its lactescency. I then took equal quantities, viz. half an ounce, of unboiled water, and of water which had been boiled over a brisk fire during the space of twenty minutes, and poured into each a few drops of the solution of *saccharum saturni*. The raw water became twice as milky as the boiled water, and deposited a much larger sediment. And I thought the water, which had been boiled twenty minutes, was less changed by the addition of sugar of lead, than that which had undergone only a slight coction. Ten drops of *sp. sal. ammon. vol.* added to half an ounce of raw spring water, turned it milky; but when added to an equal quantity of the same water, which had been boiled twenty minutes, no change was produced. Three grains of fixed alkali (*sal tartari*) dissolved in half an ounce of the same boiled water, occasioned no sensible cloudiness; but when mixed with an equal quantity of raw water, a great lactescency and copious precipitation immediately ensued. The boiled water still continued to break and curdle with soap, though in a less degree than the same water unboiled. The former, also, felt to the touch much softer than the latter.

THIS experiment clearly shews, that hard water is freed from some of its earthy salts, and rendered considerably softer by boiling. And it appears likewise, that the coction should be continued some time, in order to produce its full effect. Dr. Heberden is, indeed, of a contrary opinion; for notwithstanding he acknowledges that the unneutralized lime stone and selenite are separated by boiling from pump water, yet he thinks it becomes more strongly impregnated with the saline matter, and consequently less salutary. But in this instance the Doctor appears not to reason with his usual judgment and accuracy; and I apprehend, his observation is neither confirmed by analogy, nor supported by experiment. For though heat generally increases the dissolving power of any *menstruum*, at the same time it tends, in many instances, to destroy the texture, and disunite the component parts of the solvend. Thus hot water suspends a much larger quantity of nitre than cold water; but if the solution be boiled over the fire, a considerable portion of the salt-petre will be dissipated. If then the nitrous acid be volatilized and separated from its alkali by coction, may we not justly infer, that it will be disengaged, by the same cause, from an earthy basis, to which it bears comparatively but a weak affinity? And this reasoning may be applied with equal force to the volatile vitriolic

vitriolic or muriatic acids, which in all probability fly off by means of the boiling heat, leaving behind them an indissoluble, petrifying earth, that subsides to the bottom, and incrusts the vessel.

EXPERIMENT V. A quantity of hard pump water, which had passed through a filtering stone, when compared with the same water unfiltered, was found to be considerably softened. Each curdled with soap, but the former in a less degree than the latter. The volatile alkali occasioned no cloudiness in the filtered water, but a visible one in the other: the fixed alkali produced a precipitation in both, less however in the former, than in the latter; and the solution of *saccharum saturni* rendered the unfiltered water much more lactescent, than that which had soaked through the filtering stone.

THESE two experiments point out an easy and obvious method of purifying hard water, by freeing it, in some measure, from the unneutralized selenite, and grosser salts which it contains. The water should first be boiled for the space of fifteen or twenty minutes, then passed through the filtering stone, and afterwards suffered to stand a few hours, till it has attracted from the atmosphere a due proportion of air. Thus it will be rendered tolerably pure, salutary, and potable, and at the same time much better adapted to a va-

riety of culinary uses. If a filtering stone cannot easily be provided, the following simple contrivance may be substituted. Let a large funnel be made of wood; fill the narrow neck of it with sponge, and above the sponge spread a layer of sand and gravel; cover this with a piece of thick flannel, and place over the whole another layer of sand, leaving sufficient room for the water, which is to be filtered. Care must be taken to change the sponge, sand, &c. as often as they become loaded with the impurities of the water (*a*).

EXPERIMENT VI. Mr. Boyle asserts that some pump waters, barely by standing a few days, will become soft enough to mix uniformly with soap (*b*). A quantity of hard pump water was therefore exposed to the sun and air, but so as to be sheltered from the rain, for the space of a week. It curdled with soap, and became as milky with a few drops of a solution of sugar of lead, as water just drawn from the well. The volatile alkali, indeed, produced no cloudiness in it, and this was the only mark which it afforded of being in the least degree softened.

EXPERIMENT VII. A strong infusion of malt was not more miscible with soap, than the boiled water with which it was prepared; nor did it

(*a*) *Vid.* Lind on the health of seamen, p. 92.

(*b*) Boyle's Works, Shaw's edit. vol. I. p. 141.

suffer a less precipitation, on the addition of a few grains of *sacharum saturni*.

EXPERIMENT VIII. Strong table beer, drawn from the barrel about ten days after it had been brewed, curdled with soap as much as the hard water boiled, which was employed in its preparation.

HENCE it appears, that fermentation hath not the power of softening hard water; and that the wholesomeness of malt liquors must greatly depend upon the purity of the water, which is used in brewing them. This coincides with the following observation of Hoffman: *Bonitas cerevisiarum primò à salubri aqua dependet. Quo salubrior aqua fontana est, eo præstantiorem exhibet cerevisiam; & quo subtilior aqua, eo plus ingredientia extrahit, eoque melius fermentescit (c)*. As a season for brewing, the month of March is preferable to October, because the springs are then increased by the winter rains, and are proportionably softer and more salutary.

EXPERIMENT IX. Strong infusions of green and bohea tea, in boiled hard water, curdled with soap, and were as much changed by the addition of sugar of lead, as the boiled water itself. So that these fashionable and favourite articles of diet, notwithstanding the soft taste which they communicate to the hardest water, do not really alter

(c) Hoffman. Op. vol. I. p. 113.

or improve its nature. It were well however, if tea could be considered, in this respect, merely as innocent or useless; but it imparts many pernicious qualities to its aqueous vehicle; and the daily use of it, by insensible degrees, enfeebles the constitution, and brings on a train of nervous disorders.

EXPERIMENT X. Two or three pieces of common brick were steeped four days, in a basin full of distilled water. The water was then decanted off, and examined by various chemical tests. It was immiscible with soap, struck a lively green with syrup of violets, was rendered slightly lactescent by the volatile alkali, and quite milky by the fixed alkali, and by a solution of *saccharum saturni*. The infusion of tormentil root produced no change in it.

EXPERIMENT XI. An experiment, similar to the former, was tried with a rough piece of freestone, (*saxum arenarium*) which did not appear to have communicated any impregnation to a basin full of distilled water, in which it had been several days immersed.

THE tenth experiment affords a striking proof of the impropriety of lining wells with brick, a practice very common in many places, and which cannot fail of rendering the water hard and unwholesome. Clay generally contains a variety of heterogeneous matters, The coloured loams often

often participate of bitumen, and the ochre of iron: Sand and calcareous earth are still more common ingredients in their composition; and the experiments of Mr. Geoffroy, and Mr. Pott prove, that the earth of alum also may in large quantity be extracted from them. Now as clay is exposed to the open air for a long space of time, is then moulded into bricks, and burnt, this process resembles, in many respects, that by which the alum-stone is prepared. And it is probable that the white efflorescence, which is frequently observable on the surface of new bricks, is of an aluminous nature (*d*).

It hath long been a prevailing opinion, that water, flowing through leaden pipes, acquires certain noxious qualities. Hippocrates, and his commentator Galen, expressly condemn the use of such water; and Vitruvius, in his treatise on Architecture, remonstrates strongly against that means of its conveyance. *Multo salubrior ex tubulis aqua quam per fistulas: quod per plumbum videtur esse ideo vitiosa, quod ex eo cerussa nascitur: hæc autem dicitur nocens esse corporibus humanis. Itaque mini-*

(*d*) THE long exposure of clay to the air, before it is moulded into bricks, the sulphureous exhalations of the pit coal used in burning it, together with the suffocating and bituminous vapour which arises from the ignited clay itself, sufficiently account for the combination of a vitriolic acid with the earth of alum.

mè fistulis plumbeis aqua duci videtur, si volumus eam habere salubrem(e). Neumann, whose authority as a chemist is of great weight, gives it as his opinion, that the waters conveyed by pipes may corrode some of the matter of the pipe or of its cement, and thus contract disagreeable qualities. And he assures us, that having examined the aquæducts at Rome, those between Marly and Versailles in France, and those by which London is supplied with the New-river water, he found them in some places liable to this inconvenience(f). Doctor Falconer, in his ingenious and useful Treatise on the Waters of Bath, informs us that the leaden cistern, which serves as a reservoir for the spring at its first rise, is very much corroded on the inside, as appears by the long furrows which are very visible in every part of it. And he, with great propriety, imputes the failure of cure of many bowel disorders, and the obstinate costiveness so much complained of on drinking the Bath waters, in some measure to this cause(g). Baron Van Swieten also relates, *Vidi integram familiam hoc morbo (scilicet Colica Pietonum) laborasse, dum ad culinares usus*

(e) Vitruvius, lib. VIII. c. 7.

(f) Neumann's Chem. by Lewis, p. 248.

(g) THE waters of the hot bath are observed rather to open, than bind the body. The reservoir there is made of stone. Falconer on Bath Waters, p. 184.

adhibebatur aqua, in magno receptaculo plumbeo collecta, & diu hærens. But a celebrated writer, who has lately favoured the public with an excellent Treatise on the Poison of Lead, thinks the caution of Vitruvius and of Galen unnecessary, except in such cases where a quantity of vegetable acid might be supposed to render the metal dissoluble in water (*b*). I cannot however agree with him in this opinion, notwithstanding his experiments, at first sight, appear to be so conclusive. For I apprehend the water he employed in his trials either contained no acid, or that the acid was combined with other substances, by which it was more powerfully attracted than by lead. This metal dissolves very readily in weak *aqua fortis*, in the volatile vitriolic acid, or in oil of vitriol well diluted with water (*i*). And from Dr. Cullen's table of Elective Attractions it appears, that the last of these acids has a much stronger affinity with lead, than with the earthy basis of alum. As spring waters are, therefore, so frequently found to be aluminous, may we not with reason suspect, that in their passage through leaden pipes, the vitriolic acid will deposit the earth with which it was combined, and dissolve some portion of the metal. And thus

(*b*) *Vid.* Medical Transactions, No. 13.

(*i*) Shaw's Notes to Boerhaave's Chem. vol. I. p. 85.
the

the fountain will become impregnated with a metallic salt, of the most poisonous and deleterious quality. It is a common observation, that hard water renders pewter black; and this, most probably, arises from a solution of the lead and tin, of which this mixed metal is composed. But as a point, of so much importance to the health of mankind, ought to rest on better evidence than theoretical reasoning, the following experiment was made to determine, whether water, impregnated with alum, be capable of dissolving lead.

EXPERIMENT XII. Two clean and bright bits of lead, weighing 327 grains, were immersed sixteen days in a phial of water, in which a drachm of alum had been previously dissolved. The volatile tincture of sulphur produced no blackness in this water, until a few drops of the solution of *saccharum saturni* were added to it, and then a dusky colour immediately succeeded. The bits of lead, carefully wiped and dried, were not found to have suffered any sensible loss of weight.

THE same experiment was repeated with hard, aluminous pump water. I conceived that the lead had communicated somewhat of a sweetish taste to the water; but when a few drops of the volatile tincture of sulphur were instilled into it, it did not exhibit any appearance of a saturnine impregnation; nor had the bits of lead lost any part of their weight.

THOUGH

THOUGH the result of this experiment seems to overturn the theory before advanced, yet it does not afford me full conviction, that lead is totally insoluble in aluminous waters. For the volatile tincture of sulphur may not perhaps, in every instance, be a certain criterion of the presence of this poisonous mineral, as I have proved that green vitriol is not of the astringency of vegetables (*k*). Besides a proportion of lead, too inconsiderable to be detected by any chemical examination, may possibly, in irritable habits, and under certain delicate circumstances, prove highly injurious to health (*l*). This is confirmed by the account which doctor Tronchin has given of the colic of Amsterdam, the cause of which long eluded the researches of the learned: At last however it was discovered to arise from the use of water, slightly impregnated with lead. But conscious of the influence of a preconceived hypothesis, I have fairly stated both the reasons and facts, relating to this point, and shall leave the decision concerning them to the more unbiassed judgment of the reader. The use of leaden pumps however may be pernicious, though the conveyance of water through pipes of this metal should not be esteemed so: For by the friction of

(*k*) Experiments on Astringents, second edit. p. 150.

(*l*) *Vide* Dr. Falconer on Bath Waters, p. 187.

the bucket against the sides of the pump, some portion of lead will be rubbed off, and suspended in the water.

S E C T I O N II.

FROM the subject of this Experimental Inquiry into the different properties of hard and soft water, we are naturally led to consider their influence on many of the operations of PHARMACY. And we shall find, that the most innocent vehicle is, also the most powerful *menstruum* for extracting the virtues of medicines.

EXPERIMENT XIII. Two drachms of green tea were separately macerated, without heat, an equal length of time, the one in three ounces of hard pump water, and the other in the same quantity of distilled water. The latter infusion had a more bitter taste, and struck a much deeper black than the former, with three grains of *sal martis*.

EXPERIMENT XIV. A drachm of bark, finely powdered, was macerated two days, without heat, in three ounces of distilled water; and the same quantity, during the same space of time, in three ounces of hard pump water. The infusion made
with

with distilled water was of a paler colour than the former, but yet tasted more intensely bitter, though somewhat less rough and styptic. Two grains of *sal martis* were added to half an ounce of each infusion, carefully filtered. The latter struck a much deeper black than the former.

DISAPPOINTED in the result of this experiment, I repeated it again, but with nearly the same success as before. Twenty drops of a strong solution of *sal martis* produced at first no sensible change in half an ounce of the infusion, made with distilled water, whilst the same number of drops almost instantly struck an inky blackness with the other infusion, prepared with hard pump water. By degrees, indeed, the former assumed a dusky hue, but after standing many hours, did not half equal the blackness of the latter.

EXPERIMENT XV. Thirty drops of a solution of alum, in lime water, were instilled into half an ounce of the infusion of bark, made with distilled water. By this addition the same quantity of *sal martis*, employed in the last experiment, immediately produced a very dusky colour; and in less than an hour, the mixture assumed an inky blackness.

EXPERIMENT XVI. Two drachms of tormentil root bruised were macerated in equal quantities, viz. three ounces of hard pump water, and of distilled water, during the space of twenty-four

four hours: The latter infusion was of a deeper orange colour than the former, and had a sharper and more styptic taste. But when twenty drops of a solution of *sal martis* were added to equal portions of each infusion, an inky blackness, to all appearance precisely the same, ensued in both.

EXPERIMENT XVII. An experiment, similar to the former, was tried with Aleppo galls; by macerating two drachms of the powder in equal quantities of hard pump water, and of distilled water; but the result was somewhat different. I could not, by comparing their tastes, determine which infusion was most astringent or styptic. The one made with distilled water was of a paler colour than the other, yet it struck a much deeper black with green vitriol.

EXPERIMENT XVIII. Equal quantities of Peruvian bark powdered were macerated, without heat, forty-eight hours, in three ounces of hard pump water, and of the same pump water boiled. The latter infusion had a stronger taste of the *cortex*, but did not strike so deep a black with the solution of *sal martis*.

FROM these experiments it may be inferred, that soft water, and especially distilled water, acts far more powerfully as a *menstruum* on vegetable bitters and astringents, than hard pump water. And the conclusion may, in all probability, be extended

extended to many other classes of vegetables. The fourteenth experiment, indeed seems at first view to prove, that the Peruvian bark yields its astringency more perfectly to hard, than to soft water; but the succeeding experiment shews the fallacy of this inference: For the addition of thirty drops of a solution of alum in lime water could not give any real increase to the strength of an infusion of the *cortex*, previously prepared, although it enabled it to strike a deeper black with green vitriol. But from this curious fact we may conclude, that hard, aluminous waters are likely to answer best in the dying of black; and this is confirmed by the observation of Dr. Lewis, that alum heightens the colour of the watery tinctures of madder and brazil⁽ⁿ⁾. Mr. Chambers, in his useful Dictionary, informs us, that well-water is preferred for dying red, and other colours which require astringency, and also for dying stuffs of a loose contexture, such as callico, fustian, and cotton. Dr. Ruttty also ascertained, by experiment, that hard water extracts a tincture of a deeper hue than soft water, from logwood, brazil, fena, rhubarb, and cale.

It is found that hard, calcareous waters render the mixture of resinous bodies, by the intervention of mucilage of gum arabic, difficult, and

(n) *Vid.* Neumann's Chem. by Lewis, p. 187.

sometimes impracticable (*o*). This naturally led me to conceive, that soft or distilled water might possibly dissolve those substances, without the assistance of any medium, or at least with a much smaller proportion of gum, than is commonly employed. On suggesting this hint to a sensible and ingenious apothecary of this place, he very obligingly undertook to make the experiments for me; and has sent me the following account of the result of them, which I shall deliver in his own words. The letter contains some further trials, which do not relate to the present subject; but as they lead to several useful and important conclusions, I shall, without any apology, insert them.

(*o*) *Vid.* Lond Med. Observ. vol. I. p. 435.

JUNE 29, 1768.

DEAR SIR,

I HAVE made the experiments you desire, of dissolving resinous substances in distilled and common pump water, the result of which seems to be much in favour of the former.

ONE scruple of balsam of tolu, rubbed with half an ounce of distilled rain water, added gradually to it, for fifteen minutes, formed a mixture which, on standing about a minute, subsided, but reunited by shaking: Being set by a few days, the balsam became a concrete mass, not again miscible by shaking up the bottle.

THE same quantity required more trituration to mix it with common pump water. The mixture was not kept.

ONE scruple of the same, rubbed with fifteen grains of gum arabic, was nearly as long in perfectly uniting with half an ounce of distilled water, as that without the gum. This was perhaps owing to the latter piece being more resinous; however, though on long standing there was a small sediment, it immediately reunited, a week after, by agitation.

FIFTEEN grains of balsam *capivi* united very smoothly with half an ounce of distilled water, by the medium of three grains of gum

arabic. Five grains of the gum were not so effectual with pump water.

BALSAM of Peru ten drops, with gum arabic three grains, distilled water half an ounce, formed a neat, white emulsion, but with common water a very unequal mixture.

GUM myrrh powdered, that there might be no difference in the several quantities used, half a scruple, dissolved readily with gum arabic three grains, in both kinds of water, and even mixed with them, by longer trituration, without any medium, but more easily with distilled than common spring water. Olibanum, mastich, gum guaiacum, and galbanum may likewise be mixed with water by rubbing, without any gum arabic or egg.

THE spring water, which was made use of, was from my own pump, and is very aluminous.

IN the making of all the saline preparations, when any considerable quantities of water are used, distilled or pure rain, or river water is greatly to be preferred: For the calcareous, aluminous, and felenitical matter, which so much abounds in most spring water, will render any salts dissolved in it very impure. For several years before I came to reside in this town, I had prepared *Magnesia Alba*, even superior to that sold by Mr. Glas; but on attempting to make it here, I was surprized and disappointed to find it of greater specific gravity, and more coarse than

than usual. I was for some time unable to account for the difference, as I had conducted the process in every respect similar to my former practice; but at last discovered it to depend wholly on the variation of the water: And I always observe the magnesia to be light and pure, *cæteris paribus*, in proportion to the purity and softness of the water I make use of. Nor will this be wondered at by any one who observes the quantity of calcareous earth and selenites, which is generally deposited by the pump water of this town, when it has been boiled and has stood some time to cool.

THE solution of crude mercury with mucilage of gum arabic being so easily accomplished, and it being very disagreeable to many patients, and to some almost impossible, to swallow pills, bolusses, or electuaries; I was induced to try whether calomel, cinnabar, and the other heavy and metalline bodies, commonly administered only under these forms, might not by the same means be rendered miscible with water, so as to be given more agreeably in a liquid form.—I had indeed sometimes seen injections made with calomel and gum arabic, but had not observed whether it suspended the calomel so uniformly as to be given by the mouth.

I ACCORDINGLY rubbed ten grains of cinnabar of antimony, and a scruple of gum arabic, with

a sufficient quantity of distilled water to form a mucilage, and added a drachm of simple syrup, and three drachms more of water.

THIS makes an agreeable little draught, and having stood about half an hour without depositing any sediment, I added three drachms more of water to it, and notwithstanding the mucilage was rendered so much more dilute, very little of the cinnabar subsided, even after it had stood some days.

STEEL, simply prepared, and prepared tin were both mixed with water by their own weight of gum arabic, and remained suspended, except a very small portion of each, which was not reduced to a sufficiently fine powder.

FIVE grains of calomel were mixed with two drachms of distilled water, and half a drachm of simple syrup, by means of five grains of gum arabic, which kept it sufficiently suspended: A double quantity of the gum preserved the mixture uniform still longer. In this form it will be much more easily given to children, than in syrups, conserves, &c. as a great part of it is generally wasted, in forcing those viscid vehicles into them, and it may be joined with scammony, and other resinous purgatives by the same method, and of these perhaps the gum arabic would be the best corrector.

GUM ARABIC likewise greatly abates the disagreeable taste of the corrosive sublimate, mixed with water instead of brandy; and (from the few trials I have made) sits easier on the stomach, and will not be so apt to betray the patient, by the smell of the brandy.

MR. PLENCK, who first instructed us in the method of mixing quick-silver with mucilage, observes (and experience confirms the truth of it) that this preparation is not so apt to bring on a spitting as the *argent. viv.* mixed by any other medium, or as the saline and other mercurial preparations.—How far the theory, by which he accounts for it, may be just, is not of much importance; but it may perhaps be worth while to inquire, whether it would not be equally effectual in preventing calomel, and the other preparations of mercury, from affecting the mouth.—If so, is it not improper, where a salivation is intended, to give emulsions with gum arabic and other mucilaginous liquors, for the patient's common drink, as by that means the spitting may be retarded? And on the contrary, may it not be an useful medicine to diminish the discharge when too copious (*p*)?

BUT

(*p*) THE following case may in some measure serve to confirm the above observation.

BUT—*Ne futor ultra crepidam.* And though I am sure your friendly candour will excuse these

A GENTLEMAN, always easily affected by mercurials, having taken about twenty-six grains of calomel, in doses from one to three grains, notwithstanding he was purged every third day, was suddenly seized with a salivation. He spat plentifully, his breath was very foetid, teeth loose, and his gums, fauces, and the margin of his tongue greatly ulcerated and inflamed. He was directed to use the following gargle :

R. Gum. arab. semiunc. solve in aquæ font. bullient-selib.
 & adde mel. rosac. unc. unam. M. ft. gargar.

AND to drink freely of a ptisan prepared with aq. hord. lib. ij. gum. arabic. unc. ij. nitr. pur. drachm. ij. sacchar. alb. unc. j.

HIS purgative was repeated the succeeding morning.

THE next day his gums were less inflamed ; but the sloughs on his tongue, &c. were still as foul ; his spitting was much the same : he had drunk about a pint of the ptisan.—Some *sp. vitrioli* was added to the gargle.

FROM this day to the fourth, he was purged every day without effect—his salivation still continued, his mouth was no better—he had neglected the mucilaginous drink—this evening he was persuaded to drink about a pint of it which remained, and he had it repeated, and drank very freely of it that night.

On the fifth morning, the purgative was again repeated. Though it operated very little, yet the change was very surprizing, his mouth was nearly well, and his ptyalism greatly decreased—the ptisan was repeated, and on the sixth day being quite well, he was permitted to go abroad.

SEE also Dr. Saunders's Appendix to the second edition of Mr. Plenck's Treatise, since published.

trifling

trifling observations, which have occurred as I was writing, yet I fear I trespass upon time which you would spend much more usefully, than in perusing these indigested thoughts of, dear Sir,

Your very obliged and humble servant,

THOMAS HENRY.

EXPERIMENT XIX. It has been remarked by Professor Whytt, and many others, that different kinds of quick lime impregnate water with different degrees of strength. This suggested to me, that a diversity in the *menstruum* may also considerably vary the qualities of the lime water. And my conjecture has been confirmed by the ensuing experiments.

EQUAL quantities, viz. a quart, of distilled water, of boiled pump water grown cold, and of the same hard pump water unboiled, were severally added to half a pound of quick lime. After an infusion of twenty-four hours, the waters were decanted off, and filtered through paper. Ten drops of syrup of violets struck a deep green with the lime water made with distilled water, a lighter one with that prepared with boiled water, and the lightest with the raw pump water. Sixty drops of a solution of salt of tartar in distilled

water, added to each lime water in the foregoing order, occasioned the largest precipitation from the first, the next in degree from the second, and the least from the third. The tastes of the different lime waters corresponded also with the above-mentioned tests. For that made with distilled water was by far the most pungent, and yet the least disagreeable; whereas that prepared with raw pump water, was extremely harsh and nauseous, without being proportionably impregnated with the acrimony of the quick lime.

EXPERIMENT XX. Three fragments of human *calculi*, numbered, for the sake of distinction, 1, 2, 3, were immersed in equal quantities of different lime waters; the first in lime water made with distilled water, the second in lime water prepared with hard pump water, and the third in lime water made with the same hard pump water poured boiling hot upon the quick lime. (No. 1.) was of a brown colour and hard texture, was smooth on one side and rough on the other, and weighed twenty-six grains and a half. (No. 2.) was a fragment of the same *calculus*, and weighed twenty-five grains and a half. (No. 3.) a fragment of a different *calculus*, was of a looser and more spongy texture than the former, and weighed twenty-seven grains. The phials, which contained the *calculi* and four ounces by measure of lime water, were all nearly full, and
closely

closely corked. After continuing the maceration eight days without heat, the *calculi* were taken out, carefully dried, on filtering paper, before a gentle fire, and then weighed. (No. 1.) had lost a grain and a half, and was covered over in many parts with a soft, white, cretaceous matter. (No. 2.) had lost only half a grain: Many little crystals shot from its surface. (No. 3.) had lost a grain. But it should be remembered, that this fragment was much softer than the other two. The lime, employed in this experiment, was common stone quick lime; that, used in the former experiment, was brought out of Derbyshire, and made of a species of marble containing a great many shells in its substance. I was not aware of the difference of the lime, till after my trials were completed.

THESE two experiments, I think, satisfactorily prove, that soft water is a much more powerful dissolvent of quick-lime, than hard water (*q*), at the same time that it covers and meliorates

(*q*) To ascertain more fully this important point, I have since repeated the experiment above recited, by immersing again the fragments of the same calculus, (No. 1. and 2.) in equal quantities of fresh lime water, prepared with distilled water, and with hard pump water. In twelve days, (No. 1.) was entirely reduced to a chalky powder, whilst (No. 2.) preserved its texture, to all appearance unchanged.

the harsh taste of that acrid substance. Where distilled water cannot conveniently be provided, rain water, freed by filtration from its impurities, may with equal efficacy be substituted in its room. Had a different kind of lime been employed in the last experiment, or had the digestion been made in a sand bath, it is probable the solvent power of each *menstruum* would have been increased. The little pointed crystallizations, which were observed to shoot from the fragment of the *calculus*, (No. 2.) remind me of a similar appearance which occurred in one of the trials of the late Dr. Whytt, and which he informs us surprized him greatly. He ascribes them to the sea salt adhering, even after calcination, to the oyster-shells which he employed (*r*). But the Doctor must have been mistaken in his explanation, as in the experiment just recited, common stone quick lime alone was used, which cannot be supposed to contain any sea salt. And the crystallizations were perceived only in that phial of lime water, which had been prepared with hard pump water.

(*r*) Whytt's Essay on Lime Water, third edit. p. 74

S E C T I O N III.

A COMPARATIVE VIEW OF THE DIFFERENT PROPERTIES OF SNOW WATER, RAIN WATER, SPRING WATER, &c.

SNOW WATER is said by Mr. Boyle to be the lightest of all waters; and if received upon the tops of high mountains must, one should conceive, be free from all foreign impregnation. And yet the same accurate chemist found, on examination, that it is not entirely destitute of saltiness. But notwithstanding the superior purity of snow water, I should apprehend, that it is not the most wholesome liquor for common drink, both from its extreme coldness, and because its properties as a *menstruum* are changed by the congelation it hath undergone. For freezing decomposes water, by separating from it a considerable portion of air. And that this alters its qualities is evident from the following facts.

1. Water when fresh, dissolves a larger quantity of salt, than when exhausted of its air.
2. Water saturated with any salt, when placed *in vacuo* under the receiver of an air pump, will deposit part of its solvend.
3. Snow water is observed not to boil greens or pease so well as common water.

water. 4. The nitrous acid generates a much less degree of heat with snow water, than with common water. 5. Snow, mixed in a certain proportion with flour will, like eggs, render it when baked or boiled, perfectly light and adhesive. Hippocrates condemns the use of snow or ice water, because, after congelation, it never re-assumes its former nature; the clear, light, and sweet part of it being dissipated, whilst the most turbid and heavy is left behind. And he adduces an experiment in support of this reasoning. Expose, says he, a vessel containing a certain quantity of water to the cold air in winter time, so as that it may be frozen hard; then bring it into a warm place, where it may thaw; and when the ice is dissolved, measure the water again and you will find it evidently diminished. But this loss of bulk is not, as Hippocrates supposes, to be ascribed to the dissipation of the thinner and finer parts of the water by congelation, but chiefly to the separation of the air which it contained; and therefore his reason for condemning the use of snow water is founded on a false hypothesis. This however does not invalidate his objection to it, which at first, in all probability, he deduced from experience, and afterwards attempted to explain and confirm, by what now appears to be mistaken theory.

THE fertilizing effect of snow on the ground is universally known, and may in part arise from the covering which it affords to the earth, by which the ascent of vapours is repressed, and a fermentation promoted in the soil. But I apprehend it depends not less upon the snow being destitute of air, so that like lime, when dissolved and sunk into the earth, it abstracts air from the soil, occasions an intestine motion in its particles, and thus pulverizes them.

ICE WATER : What has been said of snow water is equally applicable to ice water, except that its specific gravity is greater, and that it is less free from saline impregnation, and consequently still less salubrious.

RAIN WATER, When collected in clean vessels, at a distance from large towns, is light, soft, and wholesome. But as it passes through the atmosphere, which is a chaos of different exhalations from the animal, vegetable, and mineral kingdoms, it must wash down some of those floating, volatile particles, and be impregnated with them. Hence rain will differ in some slight degree, according to the season of the year, as well as the country in which it falls. That it contains a quantity of adventitious matter is evident from the curious experiments of M. Margraaf, from its tendency to putrefy, from the green weed which springs up on its surface, and from

from the mucilaginous or ropy substance which grows copiously on it, and which Boerhaave compares, on viewing it through a microscope, to a grove of little mush rooms. It is observed also, after standing a while, to be full of the *ovula* of different animalcules; some of which may have been carried down with it, in its passage through the air, but the greater number are probably deposited in it, during its stagnation. But although these circumstances prove, that rain water is by no means an homogeneous fluid, or free from impurity, yet it is universally acknowledged to be the most salutary of all kinds of water. And by percolation through sand or stone, or by boiling and decanting, its foulness would in a great measure be separated, and it would be rendered a grateful, potable, and very wholesome liquor. Its levity is so great, that distilled rain water is not lighter than the natural, as Boerhaave affirms, after weighing them in the hydrostatical balance. Nor need we wonder at this, as the exhalation of aqueous vapours from the earth and sea is exactly analogous to distillation; if it be not an impropriety to compare the vast and stupendous operations of nature, with the trifling efforts of art. Hippocrates gives his testimony in favour of rain water, but directs that it should be boiled or strained; otherwise it has an ill smell,

smell, and occasions a hoarseness, and deep voice in those who drink it (*s*).

SPRING WATER: This must vary in its properties according to the nature of the soil, and different strata of earth, through which it passes. The purest is that which flows, at no great depth, through a light gravel, or sand. Dr. Hales mentions several springs remarkable for their levity, and freedom from calcareous impregnation. The water, conveyed by pipes to Hodson in Hertfordshire, which rises from a gravel, and gushes out of a fine white sand, he informs us, left no incrustation in a boiler, which had been used fifteen years. And that of Comb in Surrey, a hill, the soil of which is gravel almost to the surface, is also uncommonly light, soft, and free from all adventitious ingredients. As the springs issue from the brow of the hill, out of the gravel, the Doctor justly observes, that the water must partake greatly of the nature of rain water; since the dew and rain, which fall on that hill, receive probably no other alteration from percolating through the gravel, than that of being rendered more pure and free from foulness (*t*). Hippocrates lays a great stress upon the choice of springs, which have an eastern aspect. Such waters, he says, are chiefly to be commended,

(*s*) Hippoc. *de Aere, Aquis et Locis*.

(*t*) *Vid.* Statical Essays, vol. II. p. 242.

that gush out towards the rising of the sun; because they are clearer, lighter, and of a better smell than others. But I apprehend there is no foundation for this opinion: For water, which flows through clay, marl, black mould, or beds of minerals, will be equally hard and unwholesome, in whatever exposure it first bursts out. The purity and salubrity of it may however, with sufficient accuracy be ascertained, by its levity, transparency, and perfect insipidity; by its mingling uniformly with soap, and boiling pulse tender. And these are common tests, which it is in the power of every one to apply.

RIVER WATER: This is generally much softer, and better adapted to œconomical uses than most spring water. For though rivers proceed originally from springs, yet by their rapid motion (*u*), and by being exposed, during a long course, to the influence of the sun and air, the earthy and metallic salts which they contain are in part decomposed, the volatile acid flies off, and the terrestrial or ochrey particles, with which it was

(*u*) THE Rhine and the Rhone, which flow from the Alps, whilst they preserve the rapidity of their course, are observed to be light and pure. The difference betwixt the Rhine and the Maine is obvious to those who navigate these rivers: For the barges, which sail from the latter into the former, sink considerably deeper in the one, than in the other. Lucas. vol. I. p. 35.

combined,

combined, become insoluble, and are precipitated. To this it may be added, that rivers are also rendered softer by the vast quantity of rain water, which, passing along the surface of the earth, is immediately conveyed into their channels. But all rivers carry with them a great deal of mud, filth, and other impurities. And when they flow near large, populous, and manufacturing towns, they become the receptacles of all the common sewers, and are impregnated with an heterogeneous mixture of copperas, alum, soap lyes, log-wood, and the refuse of numberless other substances, employed in different arts. In this state, river water is certainly unfit for the common purposes of life : And yet if it be suffered to remain a while at rest, all the feculencies will subside, and the water will become sufficiently pure, grateful, and potable.

STAGNANT WATERS: These of all others are the most impure and insalubrious. Hippocrates asserts that they enlarge and obstruct the spleen; and his observation is almost daily confirmed, by the dissection of those who die of the scurvy; a disease, which putrid, stagnant water hath a powerful tendency to produce. Dr. Hoffman, by means of a glass water-poise, divided by lines, examined hydrostatically several different kinds of water. Rain water he found to be the lightest; river water was one line heavier; the water com-

monly used at Hall, in Saxony, was heavier by two lines; the spring water of the same place was four lines heavier; that of a particular spring was six lines heavier; and water, which had been long kept in an open vessel, in a cellar, was six lines and a half; but stagnant water, drawn out of the town ditch at Hall, was seven lines heavier than rain water (*x*).

I SHALL conclude this Essay with the following observations of Celsus, which, in many respects, coincide with what has been advanced. *Aqua levissima pluvialis est; deinde fontana, tum ex flumine, tum ex puteo; post hæc ex nive, aut glacie; gravior his, ex lacu; gravissima, ex palude. Facilis etiam, et necessaria cognitio est naturam ejus requirentibus. Nam levis, pondere apparet, & ex his, quæ pondere pares sunt, eo melior quæque est, quo celerius et calefit & frigescit, quodque celerius ex eâ legumina percoquantur (y).*

A REVIEW OF THE PRINCIPAL FACTS ASCERTAINED
BY THE PRECEDING EXPERIMENTS.

I. **T**HE Manchester pump water is in general very hard and impure. It is impregnated with a large quantity of selenite, and contains also no inconsiderable proportion of alum.

(*x*) Vide Hoffman Obs. Chem. p. 140.

(*y*) Celsus lib. II. cap. 18.

II. THE hardest water will become soft and miscible with soap, by the addition of salt of tartar. But such a quantity of the vegetable alkali is required, to produce this effect on the Manchester pump water, as renders it offensive to the palate, and unfit for common use.

III. HARD WATER is considerably softened by boiling. For though heat generally increases the dissolving power of any *menstruum*, at the same time it tends, in many instances, to destroy the texture, and disunite the component parts of the solvend. Thus the grosser salts contained in hard water are decomposed by the boiling heat; the volatile vitriolic or muriatic acids fly off, leaving behind them an indissoluble, petrifying earth, which subsides to the bottom, and incrusts the vessel. But the coction should be continued fifteen or twenty minutes, to produce its full effect. The water should then be suffered to remain a few hours exposed to the atmosphere, to recover its due proportion of air, before it be used. For the loss of this air, by boiling, alters the properties of water, and probably may render it less salutary.

IV. HARD WATER is softened by being filtered through stone. And if it were first boiled a sufficient length of time, and then filtered, it would be rendered tolerably pure, potable, and

Q₂

salutary;

salutary, and at the same time much better adapted to a variety of culinary uses.

V. MR. BOYLE asserts, that some pump waters, by exposure to the sun and air for a few days, will become soft enough to be miscible with soap. But this is not the case with the hard water of Manchester.

VI. NEITHER malt nor tea produce any softening effect on the hard water, in which they are infused. Nor does fermentation improve or alter its nature. So that the wholesomeness of malt liquors must greatly depend upon the purity of the water, which is employed in their preparation.

VII. BRICKS harden the softest water, and give it an aluminous impregnation. The practice of lining wells with them, which is common in many places, is therefore very improper. Free-stone communicates no pernicious qualities to water.

VIII. THOUGH by the tables of elective attractions it is shewn, that the acid of vitriol hath a stronger affinity to lead, than to the earth of alum, yet this metal does not appear, by experiment, to be soluble in aluminous waters. But perhaps the volatile tincture of sulphur may not, in every instance, be a certain criterion of the presence of lead, as green vitriol is not of the astringency of vegetables. And a proportion of this poisonous mineral, too minute to be discovered by any chemical examination, may, in irritable habits,
and

and under certain delicate circumstances, prove highly injurious to health.

IX. SOFT WATER, and especially distilled water, acts far more powerfully, as a *menstruum*, on vegetable bitters and astringents, than hard pump water. And it dissolves resinous bodies without any medium, or at least with a much smaller proportion of mucilage of gum arabic, than is commonly employed.

X. HARD, aluminous waters are likely to succeed best in the dying of black, red, and other colours, which require astringency; and also in the preparation of ink.

XI. SOFT WATER is a much more powerful dissolvent of quick lime, than hard water; and it covers and improves the harsh taste of that acrid substance. The fragment of a human *calculus* was entirely reduced to a chalky powder, by being immersed twelve days in lime-water, prepared with distilled water; whereas another fragment of the same *calculus* suffered no visible change in its texture, by being macerated an equal length of time in lime-water, made with common pump water.

XII. IN nephritic cases, distilled water would be a good substitute for Malvern water; for it is a powerful solvent of the human *calculus*.

E S S A Y VII.

ON THE DISADVANTAGES OF INOCULATING CHILDREN IN EARLY INFANCY.

*Non quæ mihi suggessit phantasiæ imaginatricis temeritas, sed
quæ phænomena practica edocere.*

SYDENHAM.

THE advantages arising from inoculation are now so universally acknowledged, that arguments in support of it seem to be entirely unnecessary. The rapid progress it hath made affords the strongest presumption, in favour of its safety and utility; and the well-attested accounts, we every day read, of the success with which it is practised, justly remove every prejudice against it, whether political or religious. The patrons of inoculation, therefore, have nothing to fear from its avowed enemies, if any such there be; but they have the utmost reason to guard against the mistaken zeal of its friends, which may
prove

prove perhaps more dangerous to its real interest, than opposition itself. Credulity, fashion, the love of novelty, and a propensity to rush from one extreme to another are principles, which have too much influence on the generality of mankind. And how unfavourable these have been to the advancement and perpetuity of improvements, might be demonstrated by numerous examples. That the artificial method of communicating the small-pox, so happily introduced amongst us, may not hereafter be added to this disgraceful list, every sincere advocate for it should exert his warmest endeavours to discourage the wanton levity, with which it is at present, in many places, adopted. For the indiscriminate use of remedies, excess in the cooling regimen, and a total disregard to age, temperament, and habit of body cannot fail, in the issue, to injure the reputation, and check the progress of one of the most important discoveries in the whole circle of physic.

IN the third volume of the MEDICAL OBSERVATIONS and INQUIRIES, Dr. MATY, a learned and ingenious physician in London, hath inserted an Essay on the advantages of very early Inoculation. He proposes that people should be induced by persuasion, and by other encouragements, if necessary, to inoculate their children as soon as possible after their birth. And this he considers as the *maximum*, to which the art of

inoculation can be brought, both with respect to individuals, and to the public. But the doctor's reasoning in support of his hypothesis, appears to me to be more ingenious and plausible, than solid and satisfactory. And I apprehend the practice which he recommends, would considerably diminish the benefits arising from inoculation, and would be of dangerous and fatal consequence to mankind. I shall endeavour, therefore, to point out the disadvantages which would attend the ingraftment of the small-pox on new-born children; and shall also make some strictures on Dr. MATY's arguments in favour of it.

I. THE number of diseases to which infants are incident, render them unfit subjects for inoculation. HIPPOCRATES, two thousand years ago remarked, *Ætatibus morbosissimi sunt juniores*. And when we consider the great and sudden changes, both external and internal, which they undergo at birth; the laxity and wonderful delicacy of their frame, and their extreme irritability perhaps depending upon it; the copiousness of glandular secretions, with the difficulty of preserving that equilibrium, the least deviation from which affects them; it is matter of real astonishment that life itself can be supported, under a series of such apparently unfavourable circumstances. Scarcely hath the little stranger been ushered into the world, but he discovers signs of
indisposition,

indisposition, by his restlessness, anxiety, crying, and vomiting; by the swelling of his belly; and sometimes by convulsions. These symptoms arise from the load of *meconium* with which the stomach and bowels are oppressed, and generally cease when those organs have been gently evacuated. The jaundice next succeeds, and is sometimes complicated with a very acrimonious state of the fluids, as appears by the eruption of little red pustules, with which the skin is every where loaded. The thrush, watery gripes, and convulsions, observe no regular order of time, but attack most infants, either singly or collectively, according as they are more or less obnoxious to the causes which produce them. The quick growth of children in the first period after birth, is likewise a source of numerous ailments; notwithstanding the provision which nature hath made, to guard against the inconveniences resulting from it, by the laxity of the glandular system. The sudden enlargement of the foetus, in the womb of the mother is truly surprizing. Dr. HARVEY relates, that in the deer kind, he observed the *punctum saliens*, on the 19th or 20th of November. On the 21st he saw the *vermiculus* or embryo of the animal; and on the 27th the foetus was so perfect, that the male might be distinguished from the female; the feet were formed, and the hoofs were cloven. This rapid growth

growth must be ascribed to the soft and yielding structure of the foetus; to the plenty of nutrition it receives; to its exemption from all discharges; and to the proportionably strong action of its little heart. And as most of these causes continue to exert their influence after birth, though in a less degree, the increment of the young animal proceeds apace, and redundances are formed, which in a healthy state are carried off by one or other of the glandular excretions. But a deficiency or excess in any of these, necessarily produces diseases. And in such feeble, delicate, and irritable subjects, the equilibrium cannot long be preserved. If they are defective, all the complaints which arise from plenitude ensue; the child grows feverish, dull, and comatose; his stomach is disordered; his bowels are oppressed with wind; and if his belly be constipated, he falls into convulsions. On the other hand, if they are excessive, a *diarrhœa* is produced; *aphthæ* and severe gripes succeed; and the violent irritation seldom fails to occasion epileptic fits. From this short view of the first period of infancy, I think it must appear evident, that inoculation is ill adapted to that tender season of life. Nature, feeble and irritable as she then is, can scarcely struggle with the diseases to which she is ordinarily exposed. It is therefore equally cruel and unjust to add to the number with which she is already oppressed.

oppressed. For it is demonstrable from the bills of mortality, that two thirds of all who are born, live not to be two years old; and I think it is more than probable, that a considerable proportion of these, die under the age of six weeks.

II. THE fears and anxiety of the mother, excited at a time when her strength hath been exhausted by the pains of labour, and when every uneasy impression should be cautiously avoided, cannot fail to injure her milk. And this is a powerful objection to the early ingraftment of infants. If a hired nurse be employed, her milk may disagree with the child, she may fall into some disease during the time of inoculation, may be guilty of excess in eating or drinking, or may be under the influence of violent passions; each of which will aggravate the symptoms, and increase the danger of the artificial distemper, under which the infant labours (*a*).

3. IT

(*a*) INFANTES ex assumpto lacte nutricis, quæ brevi ante ira vel terrore perculsa fuit, in gravissima pathemata, convulsiva, epileptica, & sævissima alvi tormina incidant.

Hoffman. Op. vol. I. p. 196.

A CHILD, whose mother was its nurse, became feverish on the third day of eruption, which caused violent anxiety in the mother; a rash with costive belly, was then observed, and the child died on the second day after it. *Monro's Acct. of Inoc. in Scot. p. 25.*

A NURSE

III. IT hath been observed, by a very able and experienced practitioner (*b*), that young children have usually a larger share of pustules from inoculation, than those who are a little farther advanced in life: And that, from this circumstance, so many have died, as to discourage the practice of ingrafting the small-pox on such delicate subjects. This fact is not easy to be explained. Whether the greater irritability of infants subjects them to be more affected with the variolous *miasma*, than children of two or three years old; or whether the larger eruption, to which they are liable, be owing to the proportionably greater quantity of their fluids, I will not presume to determine. Both causes may possibly conspire to produce this effect; the former by exciting a quicker, and increased contraction of the heart and vascular system; the latter by affording a more copious *pabulum* for the variolous ferment.

A NURSE of an inoculated child who died, was discovered to have drunk immoderately of malt liquor, during the process of inoculation.

Monro's Acc. of Inoc. in Scot. p. 33.

THE nurse of an inoculated child who died, was suspected to have been tainted with the Lues Venerea, by her husband, who was afterwards discovered to have had the disease, and at the time she was nursing the child.

Monro's Acc. of Inoc. in Scot. p. 33.

(*b*) BARON DIMSDALE.

By

By the same principles we may perhaps account for the greater virulence of the *lues Venerea*, in infancy, than in the more advanced stages of life.

IV. A CONSIDERABLE number of those who die of the natural disease, before the expulsion of the variolous eruption, are infants, or very young children (*c*). This does not arise, as Dr. KIRKPATRICK supposes, from the extreme weakness of the *vis vitæ* of infants; for the contraction of their hearts is proportionably stronger than in adults, as the quickness of their growth evinces; but from the high degree of irritability with which their nervous system is endued. Hence the convulsive paroxysms, which often precede the appearance of the pustules, and which, though regarded by SYDENHAM as no unfavourable signs, are always alarming, and when they happen to very young infants, are frequently fatal.

V. If the number of pustules be so great in the mouth or throat as to obstruct suction, the disease, in all probability, will prove fatal. Even a few pocks, in those parts, are highly troublesome and dangerous to infants; for besides the pain and restlessness which they produce, they often terminate in ill conditioned ulcers (*d*). Under such circumstances the mute wailings, or shrieks, of an infant occasion equal embarrassment and distress.

(*c*) KIRKPATRICK'S Analysis.

(*d*) Vide SCHULTS on Inoculation.

VI. THOSE who are affected with cutaneous diseases, have been generally regarded as unfavourable subjects of inoculation (*e*). Infancy, therefore, which is seldom unattended with eruptions on the skin, must be an improper period for receiving the small-pox by ingraftment.

VII. THE thickness of the teguments of infants, which arises from the quantity of fluids interposed between their fibres, by which the skin is rendered soft and œdematous to the touch, and their perspiring less than children who are capable of using exercise, are further objections to very early inoculation.

VIII. BUT the most forcible argument against this practice, is deduced from the ill-success which hath attended infant inoculation in general. For it appears by Dr. JURIN's account of the progress of inoculation in Great Britain from 1721 to 1726, and by Dr. SCHEUCHZER's continuation of it to 1728, that of fifty-eight children under two years old, who received the small-pox by ingraftment, six died; whereas of two hundred and twenty-one, inoculated between the ages of two and five, only three died.

HAVING thus pointed out some of the principal objections to the early inoculation of infants, I shall make a few remarks on Dr. MATY's inge-

(*e*) DR. JURIN's Account of Inoculation.

nious Essay in favour of it. After enumerating the advantages which infancy has with regard to the small-pox, the Doctor sums up the whole by saying: "If there is a period in which the machine is in a perfect state, it certainly is immediately before it begins to be spoiled, or at the first period after nativity (*f*).” This assertion, I apprehend, is repugnant to reason, anatomy, and experience. It seems to be a general law of nature, that all organized bodies should advance by progressive stages to their acme or state of perfection; and should then decline by the same regular gradation. A plant, when it first springs out of the ground, is frail and tender; by degrees the stem thickens, the leaves expand themselves, the juices are concocted, the flower opens, the seed is formed, ripened, and shed; and when the office assigned it by the sovereign Creator is thus accomplished, it droops, withers, and falls into decay. The animal world furnishes still more striking proofs of the truth of this observation. And I know nothing which contributes more to the beauty and harmony of the universe, or affords a more admirable display of the wisdom of its great Author, than the order and uniformity with which these successive changes are carried on, amongst the different classes of beings.

(*f*) Medical Observations, vol. III. p. 290.

FROM

FROM the researches of anatomists into the structure of the human body, it is evident that our machine, in infancy, is comparatively imperfect; that its parts are disproportionate; and its organs incapable of those functions, which they are destined in future life to perform. The head of a new-born child, bears a much larger proportion to the bulk of his body, than that of an adult; the former being as one to three, the latter only as one to eight. And this, joined to the remarkable laxity of the fibres in infancy, is the reason perhaps of the excessive irritability with which the body is then endued, and which lays a foundation for numerous diseases. The liver and pancreas are so immensely distended, as to fill up almost the whole cavity of the abdomen; and the copiousness of their secretions is equal to their bulk. The bile, cystic and hepatic, is almost insipid, and so inert that it is incapable either of promoting digestion, or of neutralizing those acridities, which the weakness of the stomachs, and the acescency of the food of infants, generate in the *primæ viæ*. Hence, probably, arise the crudities, flatulency, gripes, aphthæ, and convulsions, to which children, at that tender age, are peculiarly exposed. The heart, with respect to the vascular system, is both stronger and more bulky
in

in infancy, than in after life. (g) By this means the blood is propelled with greater force; and as the arteries, at that period, have less firmness and density than the veins, as appears by Sir CLIFTON WINTRINGHAM's experiments, they are then most yielding and distensible. And both these causes equally conspire to promote and quicken the growth of the young animal. But wise and necessary as this provision of nature is, it unavoidably exposes the infant to all the dangers which arise from a *plethora*, and must be considered as a present imperfection, however well adapted it may be to those progressive changes, which advance him from childhood to maturity. For, by degrees, the heart abates of its proportional force, and the arteries acquire their greatest amplitude. At this period, the moving powers of the machine are equally balanced, and the body seems to enjoy, for a while, a state of rest.

(g) By the curious tables of Dr. BRYAN ROBINSON, it appears, that the weight of the heart, with respect to the weight of the body, is greater in a child than in a man, in the proportion of three to two: that the quantity of blood, which flows through the heart in a given time, is greater in a child than in grown bodies, in the proportion of twenty to seven, which is the proportion of their pulses in a minute: and that the velocity of the blood is greater in a child than a man, in the proportion of eighty to seven.

But the delicate equilibrium cannot long be maintained: The heart grows feeble and languid; the arteries gradually contract themselves; a venous plenitude ensues; and old age closes the scene.

BUT analogy may deceive us, and the observations of anatomists may be doubtful; experience however carries conviction along with it, and incontestibly demonstrates, that the human body, contrary to the assertion of Dr. MATY, is most imperfect in the first period after nativity. For it is universally acknowledged, that infancy is liable to a much greater variety of maladies, than any other stage of life. This can arise only from the extreme delicacy of the structure, and disproportion of the parts of new-born children; and both the cause and effect, in this instance, are marks of frailty and imperfection.

“CONVULSIONS in young babes, says Dr. MATY, seem to be not so much a disease, as an indication of some disorder in the bowels, or the effort of nature to expel some enemy (*b*).” The observation is, in general, just; for I believe the true idiopathic convulsions happen very rarely. But though somewhat less alarming on this account, these fits are always attended, in such feeble and delicate subjects,

(*b*) Medical Observations, vol. III. p. 292.

with imminent danger. Many, it is well known, have expired under them; whilst others, who have struggled through with great difficulty, have been so debilitated, and their faculties so impaired, that the effects have been perceptible during the remaining part of their lives (*i*). The convulsions about the time of the eruption, and subsiding of the inoculated small-pox, says Dr. Monro, are the most frequent bad symptom in this disease; and by them more of those, in the column of dead, lost their lives, than by any other cause (*k*).

“THAT disposition in the intestinal tube to
“excoriate, which arises from the too great
“acrescency of milk or vegetable aliments, is
“easily corrected by magnesia, lime water, oil,
“and by small quantities of broth or other ani-
“mal food (*l*).” The remedies, which Dr. MATY hath here pointed out, are very judicious and proper; but their effects are much more uncertain than he seems to apprehend. The ailments of children are generally very complicated; and the indications of cure are often obscure and doubtful. In their irritable bodies, one symptom frequently brings on a variety of

(*i*) DIMSDALE on Inoculation.

(*k*) Monro's Account of Inoculation in Scotland, p. 25.

(*l*) Medical Observations, vol. III. p. 293.

others, sometimes connected with the original one; at other times, to all appearance, totally dissimilar. And these symptoms of symptoms, as they are termed, do not always cease, when the cause, which first produced them, is removed. This every physician experiences, who is conversant with the diseases of infants; and it necessarily occasions, in his treatment of them, some degree of difficulty and confusion.

FROM the lists of Dr. JURIN, and Dr. SCHEUCHZER, Dr. MATY finds that nine out of two hundred and seventy-three, i. e. one out of thirty, inoculated under five years of age, died between the years 1721, and 1728. But if the doctor had confined himself, as he ought to have done, to the list of those who died by inoculation under one year old, he would have found the proportion to be vastly greater, viz. no less than one in twelve. But as even one in thirty is a great mortality, and as the operation in grown people, during that period, appears to have carried off only one in fifty; Dr. M. endeavours to obviate this objection, in the following manner:

“As so many more children, under five years,
 “die of different disorders, than at any other
 “age, it is more than probable that several, per-
 “haps most of these nine would have died,
 “though they had not been inoculated (*m*).”

(*m*) Medical Observations, vol. III. p. 295.

But

But though the Doctor has given some good reasons for presuming upon this probability, I would ask him, wherein consists the justice or propriety of ingrafting the small-pox, at a period when, from the instances he himself adduces, the risque appears to be so great of other dangerous, and fatal distempers acceding to it? For slightly as this artificial disease is now regarded, it is of itself sufficient for the powers of nature to struggle with, in early infancy.

THE second part of Dr. MATY's Essay displays the political advantages, which would accrue from the early inoculation of infants. But if it be evident, from what has been advanced, that the practice he recommends, is prejudicial to individuals, it will require no arguments to prove that it must be equally so to the public. The absurd custom of separating, in the bills of mortality, the ages of those who die, from the diseases by which they are carried off, renders it impossible to ascertain, with precision, the risk of the natural small-pox, which is incurred by delaying inoculation. But from my own experience, as well as from the observations of the most intelligent of my medical friends, I should conclude this risk to be very trifling; and that the small-pox is a distemper to which children, in the first period of life, are rarely liable. For, at that tender age, they are neither in the way of infection, nor

are they much disposed to receive it. Dr. Monro informs us, that of twelve infants, inoculated within a fortnight after their birth, not one had the variolous eruption (*n*).

To conclude : Though infants are less proper subjects for receiving the small-pox by ingraftment, than children a little further advanced in life, yet it must be confessed, that such circumstances may occur, as to render the inoculation of them highly expedient and advisable. In such cases however, I think the age of two or three months is preferable to the period which Dr. MATY recommends. For it will then be too early to apprehend any disturbance from dentition ; and yet the child will have surmounted some of the diseases, peculiar to the first stage of its existence. The chylopoietic organs will also, by that time, have been so strengthened by exercise and habit, as to discharge their functions with some degree of regularity. But the fittest season for inoculation seems to be, between the age of two and four years, in healthy children, and of three and six in those who are extremely tender and delicate. The powers of nature are then sufficiently vigorous ; perspiration is free and copious ; the irritability of the body is greatly diminished ; the viscera are sound and unob-

(*n*) Monro on Inoculation, p. 25.

structed ;

structed ; the mind, though active and lively, is not disturbed by violent emotions ; the teguments are properly extenuated ; and the fibres are neither too tense, nor too lax, for the variolous eruption. To these important advantages may be added, that, at this age, the child is both a proper subject for preparatory medicines, and for such as may be deemed necessary during the course of the distemper. It is no wonder therefore, that the practice of inoculation is attended with most success at this period. And it is seriously to be lamented, that the precious opportunity should ever be neglected.

E S S A Y VIII.

ON THE

EFFICACY OF EXTERNAL APPLICATIONS

IN THE

ANGINA MALIGNA,

OR

ULCEROUS SORE THROAT.

THE ANGINA MALIGNA is, for the most part, so rapid in its progress, that it requires all the assistance of art to counteract its malignity, and to prevent its fatal termination: And when children are attacked with it, we are often reduced to the most distressing perplexity, from the difficulty of persuading, or the danger and impossibility of forcing them to use those means which are necessary for their relief. It has been my misfortune lately to attend several such forward patients, whose cases, independent of their perverseness, afforded the most unfavourable prognostics,

nostics, and obliged me to depend entirely on external applications. The following method of cure I have hitherto successfully pursued.

A PLASTER, composed of *Emplast. Stomach.* or *Emplast. à Cymino* p. ij. *Emp. Vescic.* p. j. *Camph. S. V. R. trit.* ʒiss, is directed to be applied to the nape of the neck, and a cataplasim of *Cort. Peruv. & Flor. Chamæm.* boiled in vinegar, with the addition of two drachms of camphor, to be laid across the throat, and renewed every four hours. Sometimes, instead of this cataplasim, a flannel, moistened with equal parts of camphorated spirit of wine and vinegar, is recommended, which is highly refreshing and grateful to the patient.

A PEDILUVIUM, consisting of the above-mentioned ingredients, viz. bark and chamomile flowers, boiled in vinegar and water, is prescribed to be used three or four times in a day. When the weakness of the patient renders him unable to sit with his feet in the bath, cloths, lightly wrung out of the decoction, are ordered to be wrapped round his legs and thighs.

To medicate the air, both for the benefit of the patient and of his attendants, such a composition as Dr. Huxham recommends, viz. chamomile flowers, rosemary, and myrrh, with vinegar, is advised to be kept boiling over the lamp of a tea-kettle, so that the vapour, which
is

is by no means disagreeable, may be diffused through the room; and the lamp is sometimes placed near the bedside of the sick person, that he may inspire the antiseptic steams more copiously.

My reason for prescribing a blistering plaster, under the form above directed, is because I have found by experience, that the skin, in this disorder, is very easily inflamed and vesicated; and that a sufficiently copious discharge of serum is procured by this composition, which at the same time coincides with the general indication of correcting putridity. And I must here take leave to remark, that early blistering, in the *angina maligna*, has a peculiarly good effect; though I am no advocate in general for the application of vesicatories, in the beginning of fevers.

THE cataplasm seems to me to answer several useful purposes: It tends to soften and relax the glands of the neck, which are often tumefied in this disorder; it continually exhales an antiseptic vapour, which is drawn into the mouth and fauces, at every inspiration; and no inconsiderable portion of it is carried into the system, by absorption. And it appears not improbable, from the common methods of preventing putrefaction in animal flesh, that some part of it may pass to the seat of the disease, by penetrating through the interstices of the muscular fibres, when the cellular membrane is not loaded with fat.

THE use of the *pediluvium*, in every species of fever, is acknowledged to be highly serviceable, and is peculiarly so in this disorder, in which the skin is hot and dry, and the efflorescence on the surface of the body apt to disappear, from the slightest causes, producing an aggravation of all the symptoms. Besides its relaxing and antispasmodic effects, it tends to bring on a swelling of the feet, which I have sometimes observed to be so beneficial to the patient, as almost inclined me to think it a critical derivation. By the addition of bark, chamomile flowers, and vinegar, the *pediluvium* is rendered powerfully antiseptic, without any diminution of its other effects. An ingenious writer has proposed a method of conveying a very large portion of nitre into the body, as a corrector of putrefaction; but in the sore throat, and every putrid disease, could such a quantity be introduced into the course of the circulation, it would probably disappoint our expectations, and by weakening the *vis vitæ* increase the septic ferment.

THESE means, assiduously pursued, have hitherto succeeded to my wishes, though I should not chuse to trust to them alone, when other remedies could be employed. However such is my confidence in their efficacy, that I would never fail to recommend them, along with frequent gargling, and the internal use of the *cortex*, wine, &c.

AN eminent practitioner has very judiciously recommended, in the first stage of the disorder, the washing of the stomach with a gentle emetic. This advice I have generally pursued, and have always observed, that it mitigated the violence of the symptoms, and, in some instances, has entirely removed the disease. The efficacy of emetics, in this distemper, is not to be ascribed solely to the evacuation, which they produce, of the contents of the stomach, but to their unloading the glands of the throat, promoting an equal circulation, and increasing perspiration.

I do not recollect that any authors have taken notice of a symptom, which has not unfrequently attended the sore throat, as it has appeared in this neighbourhood; I mean a very foetid, ichorous discharge from the ears. In the beginning of the present summer, (1770) this symptom occurred only in the worst cases, and such as generally proved fatal: I have lately observed it several times when the patient has recovered; but indurated parotids, and deafness have ensued.

I HAVE met with cases, in which all the symptoms of the *angina maligna* have appeared, excepting the ulcers of the throat: Nor could there be any doubt concerning the nature of the disease, as the patients had been exposed to the infection of it. These instances, I apprehend, incontestibly prove the ulcerous sore throat to be a
distemper

distemper of the whole habit, and not almost entirely a local affection, as may be inferred to be the opinion of a very learned and eminent physician, (whose writings contain a treasure of medical knowledge,) from his laying *the chief stress of the cure on gargling*.

THOUGH we should be cautious in the use of the vegetable acids, on account of their tendency to renew or increase the *diarrhæa*, yet the mineral acids are not liable to this objection, and I think may be administered with great advantage. I frequently direct the dulcified spirit of nitre to be given freely, in an infusion of red rose leaves, mixed with port wine. It is cordial, antiseptic, and gently diaphoretic, and thus answers several very important indications.



E S S A Y S

MEDICAL, PHILOSOPHICAL,

A N D

EXPERIMENTAL:

P A R T II.

----- Sicut formica,

Ore trahit quodcunque potest, atque addit acervo.

HOR. Lib. I. Sat. I.

T H E

P R E F A C E.

TH E great Lord Verulam recommends the collection and collation of facts, observations, and experiments, as the best method of promoting the improvement of phyfic; and experience hath fully evinced the utility of such a plan. In this way, I am ambitious of contributing my mite to the general stock of medical knowledge; and shall think myself happy, if I can thus render the pursuit of my own instruction and amusement, subservient to the interests of my profession, and to the general good of mankind.

THE Observations on the - COLUMBO-ROOT have been read at the College of Physicians, and before the Royal Society; and have been communicated to a considerable number of my friends and correspondents,

to some of whom this remedy was unknown, and by others applied only to the cure of the *cholera morbus*. During the course of the last year (1772) I have had the satisfaction of receiving from them the strongest testimonies of its efficacy, in a variety of disorders. What I have advanced, therefore, in its favour, may be regarded, not as the conclusions of an individual, partial to a favourite remedy, but as facts supported by the experience of many learned and ingenious physicians.

THE dissertation on the ORCHIS ROOT has been honoured, by Dr. Hunter of York, with a place in the Georgical Essays, a useful and entertaining work on the subject of agriculture. But as it contains some experiments and observations on the medicinal qualities, as well as on the culture and preparation of this root, it is here reprinted, with a few corrections and additions.

THE papers on FACTITIOUS AIR form a part of an experimental inquiry into this interesting and curious branch of physics,
in

in which the friendship, and too favourable opinion of Dr. Priestley first engaged me, in concert with himself. But this learned philosopher, who possesses a happier genius, more leisure, and better health than I am blest with, has carried his researches far beyond the limits of mine; and his pleasing and wonderful discoveries, in these almost trackless regions of science, will reflect the highest honour on his industry and abilities.

To these Experimental Essays, I have annexed a few select HISTORIES of DISEASES, agreeably to the plan of Lord Bacon, who advises physicians
 “to revive the Hippocratic method
 “of composing narratives of particular cases, in which the nature of the
 “disease, the manner of treating it, and
 “the consequences are to be specified;
 “to attempt the cure of those diseases,
 “which have been too boldly pronounced
 “incurable; and to extend their inquiries
 “into the powers of particular medicines,
 “in the cure of particular disorders (*a*).”

(*a*) De Augment. scient. L. IV. cap. 2.

THE PROPOSALS, for establishing more accurate and comprehensive BILLS of MORTALITY, were suggested by the perusal of a Treatise on Reversionary Payments, lately published by my friend Dr. Price; who employs his great mathematical knowledge, not in idle speculation, or in the solution of amusing problems, but in disquisitions at once curious, instructive, and of the highest importance to the interests of mankind. The Plan has been honoured with his approbation, and is likely to be carried into execution at Manchester.

I CANNOT take my leave of the candid reader, without intimating that, though the experiments contained in these sheets were made with great care, and are related with the strictest fidelity, I am sensible many inaccuracies may have escaped me; which those will most readily excuse, who have experienced the difficulties incident to such researches. The philosopher has frequent occasion to lament both the fallacy of his senses, and the limited powers

powers of his understanding. “ You will
 “ wonder,” says Mr. Boyle, in the preface
 to his Philosophical Essays, “ that I
 “ should use so often *perhaps, it seems,*
 “ ’tis not improbable, words which argue
 “ a diffidence of the truth of the opinions
 “ I incline to. But I have hitherto not
 “ unfrequently found that what pleased
 “ me for a while, was soon after disgraced
 “ by some further, or new experiment.”
 Such is the imperfection of human know-
 ledge, even when derived from evidence,
 which is usually regarded as the most
 clear, and incontestible. And so true is
 the sentiment of the comic poet,

*Nunquam quisquam ita bene subducta ratione ad vitam fuit,
 Quin res, ætas, usus, semper aliquid apportet novi,
 Aliquid admoneat, ut illa, quæ te scire credas, nescias;
 Et, quæ tibi putaris prima, in experiundo repudies.*

TERENT.

MANCHESTER,

Jan. 1, 1773.

E S S A Y I.

OBSERVATIONS AND EXPERIMENTS

ON THE

C O L U M B O - R O O T.

----- *Symbolum aliquid, utcunque exiguum, in commune
medicinæ ærarium contribuerem.*

SYDENHAM.

THE Columbo-root, though a medicine of considerable efficacy, is not yet generally known in practice. Books, so far as my reading extends, are silent about it; and I have not hitherto been able to obtain any satisfactory information concerning its Natural History. The celebrated Linnæus is unacquainted with it. Dr. Watson made particular inquiry concerning it of an East-India Governor, and also of Mr. Loten, who was several years Governor of Ceylon. These Gentlemen informed him only that the root was brought to Ceylon, and to our settlements, where it is called, in the Portuguese language, *Rajis de Mosambique*. Dr. Hope, Professor of Botany at Edinburgh, has

transmitted to me the following account, which he received from Dr. Rainey, a Physician who resided a long time in the East-Indies. The Columbo-root grew originally on the continent of Asia, and was thence transplanted to Columbo, a town in Ceylon, which now gives name to it, and supplies all India with it. The inhabitants of these countries have for a long time used it, in disorders of the stomach and bowels. They carry it about with them, and take it sliced or scraped, in Madeira wine.

THE Columbo-root comes to us in circular pieces, from half an inch to three inches in diameter; and divided into *frusta*, which measure, in length, from two inches to one quarter of an inch. The sides are covered with a thick, corrugated bark, of a dark brown hue on its external coat, but internally of a light yellow colour. The surfaces of the transverse sections appear very unequal, highest at the edges, and forming a concavity towards the centre. On separating this surface, the root is evidently seen to consist of three *lamina*, viz. the cortical, which in the larger roots is a quarter of an inch thick; the ligneous, about half an inch; and the medullary, which forms the center, and is near an inch in diameter. The last is much softer than the other parts, and when chewed seems very mucilaginous: A number of small fibres

run

run longitudinally through it, and appear on the surface. The cortical and ligneous parts are divided by a circular black line. All the thicker pieces have small holes drilled through them, for the convenience of drying.

THIS root has an aromatic smell; but is disagreeably bitter, and slightly pungent to the taste, somewhat resembling mustard-seed, when it has lost, by long keeping, part of its essential oil. Yet though ungrateful to the taste, when received into the stomach it appears to be corroborant, antiseptic, sedative, and powerfully antiemetic.

IN the CHOLERA MORBUS it alleviates the violent *tormina*, checks the purging and vomiting, corrects the putrid tendency of the bile, quiets the inordinate motions of the bowels, and speedily recruits the exhausted strength of the patient. Mr. Johnson of Chester, a surgeon of eminence, who served ten years on board one of his Majesty's ships in the East-Indies, and in 1756 had the care of an hospital-ship, gave the Columbo-root in that climate to a great number of patients, often twenty in a day, attacked with this disease. He seldom employed any means to promote the discharge of bile, or to cleanse the stomach and bowels, previous to its exhibition: And he generally found that it soon stopped the vomiting, which was the most fatal symptom, and that the purging, and remaining complaints, quickly yielded

yielded to the same remedy. The mortality on board his ship, after he used this medicine, was remarkably less than in the other ships of the same fleet; and this difference he attributes entirely to the good effects of the Columbo-root, in this fatal disorder. The dose he gave was from half a drachm to two drachms of the powder, every three or four hours, more or less according to the urgency of the symptoms.

THOUGH Columbo-root does not seem to possess much, if any degree of astringency, yet I have often observed very salutary effects from its use, in DIARRHOEAS, and even in the DYSENTERY. In the first stage of these disorders, when astringents would be hurtful, this root may be prescribed with safety and advantage, for by its antispasmodic powers, it corrects the irregular action of the *primæ viæ*. But as a cordial, tonic, and antiseptic remedy, it answers better when given towards their decline.

I HAVE more than once experienced its efficacy in the vomitings which attend the BILIOUS COLIC; and in such cases where an emetic is thought necessary, after administering a small dose of ipecacuan, the stomach may be washed with an infusion of Columbo-root. This will answer the purposes of an evacuant, as well as chamomile tea, and will tend to prevent those violent and convulsive reachings which, in irritable habits, abounding

abounding with bile, are sometimes excited by the mildest emetic. The efficacy of ipecacuan in the colic, given in small doses, is well known; and perhaps its operation as an antispasmodic may, in some measure, depend on the nausea which it produces. But unfortunately it often occasions very severe sickness and vomiting, and thus aggravates the disorder, by inducing a new and most distressing symptom. Perhaps (for I speak not from experience) if it were combined with some grateful aromatic, and administered in an infusion of Cumbo, prepared with mint water, this troublesome effect might be obviated.

IN BILIOUS FEVERS, fifteen or twenty grains of this root, with an equal or double quantity of vitriolated tartar, given every four, five, or six hours, produce very beneficial effects. The neutral salt abates the febrile heat, allays thirst, and brings on a gentle salutary *diarrhœa*; whilst the Cumbo-root supports the strength of the patient, obviates the nausea and sickness to which he is so much disposed, and powerfully checks the septic ferment in the *primæ viæ*. When the belly is sufficiently soluble, an infusion of it may be directed, in conjunction with the dulcified Elixir of Vitriol (*a*). Is it not probable, that the Cumbo

(*a*) DR. HAYGARTH, a very ingenious physician at Chester, has lately, by my recommendation, made trial of
the

Columbo-root may be highly serviceable in the malignant, YELLOW FEVER of the West-Indies? This fever is always attended with great sickness, violent reachings, and a copious discharge of bile.

the Columbo-root, in a fever of the bilious kind, which has been epidemic at Namptwich, and in other parts of Cheshire; and he has favoured me with the following account of his success. “ After the *primæ viæ* have
 “ been sufficiently unloaded of their bilious, and other
 “ putrescent contents, I find the Columbo-root a most
 “ useful remedy, in allaying the nausea and reachings,
 “ to which the patients are liable. In this fever,
 “ though the remissions are very evident, and the ac-
 “ cessions generally marked with chills, and other symp-
 “ toms of an intermittent, yet the bark appears to do
 “ more harm than good, as it occasions an increase of
 “ feverish heat, and a parched tongue. The Columbo,
 “ in these cases, seems to supply its place most admi-
 “ rably, by correcting the bile, restoring the proper
 “ tone of the stomach, and of the whole habit. It also
 “ prevents relapses, to which, in this fever, the patients
 “ are particularly disposed.

“ Such have been the good effects of the Columbo-
 “ root in the cases which have fallen under my own
 “ observation; but a judicious Apothecary informs me,
 “ that he has often seen it fail of success in this fever,
 “ which in no respect seems wonderful. It is not sup-
 “ posed that Columbo has any febrifuge quality, similar
 “ to antimony, or Peruvian bark. By correcting the
 “ putrid bile it destroys the *fomes* which aggravates the
 “ fever, and produces many of its most dangerous symp-
 “ toms. When bilious fevers are epidemical, does it
 “ not seem a probable remedy to prevent the disease?”

The

The vomiting recurs at short intervals, often becomes almost incessant, and an incredible quantity of bile is sometimes evacuated, in a few hours.

CHILDREN, during DENTITION, are frequently subject to severe vomitings and diarrhœas. In these cases the Columbo-root is an useful remedy; and I have seen almost instant relief procured by it, when other efficacious medicines had been tried in vain. The more effectually to correct the acidities, which at such times usually prevail, a little chalk or magnesia may be combined with it.

THE Columbo-root is extremely beneficial in a LANGUID STATE of the STOMACH, attended with want of appetite, indigestion, nausea, and flatulence. It may be given either in substance, with some grateful aromatic, or infused in Madeira wine, and during the use of it, gentle doses of the tincture of rhubarb, or of any other strengthening and cordial purgative, should occasionally be prescribed. If the bile appear to be defective, a sufficient quantity of ox gall, carefully evaporated to the consistence of an extract, may be mixed with the powder of Columbo, and the mass reduced into pills. In this manner I have frequently taken the Columbo-root myself, and have generally found my appetite increased, and my digestion improved by it.

HABITUAL VOMITING, when it proceeds from a weakness, or irritability of the stomach, from an irregular gout, from acidities, from acrimonious bile, or an increased and depraved secretion of the pancreatic juice, is greatly relieved by the use of Columbo-root, in conjunction with aromatics, chalybeates, or the testaceous powders. But this disease often arises, when such a cause is least suspected, from an affection of the kidneys. Under such circumstances, demulcents, and gentle diuretics, are the most successful remedies; though I have frequently observed temporary relief procured by a light infusion of this root in mint water.

SUCH an infusion succeeds better than any other medicine I have tried, in the nausea and vomiting occasioned by PREGNANCY. But it is sometimes necessary to premise venæsection, and always expedient to keep the patient's body moderately open with magnesia.

I COULD illustrate the truth of these observations, by a variety of cases; but to enter into so minute a detail would be equally unnecessary and uninteresting. I shall confine myself therefore to the relation of a few histories, which exemplify the peculiar, or, if the expression be allowable, specific qualities of the Columbo-root.

CASE I. T. H. of Newton-lane near Manchester, in the month of August 1770, from
exposure

exposure to cold, when overheated with hard labour, was attacked with a severe purging and vomiting, accompanied with violent pain in his stomach and bowels. He continued in this miserable condition twenty-four hours before I saw him, and his strength was then nearly exhausted. I directed two scruples of the powder of Columbo-root, to be given every three or four hours in pepper-mint water. This remedy afforded almost immediate relief; but the patient returning too soon to his occupation, had a relapse, and was again restored to health by the same medicine.

CASE II. (*b*) W. W. August 31, 1770, had been seized with a looseness three days before, which had gradually increased, and for the last four hours, been most violent, attended with frequent vomiting, and cramps in his extremities. He was directed to take a scruple of the powder of Columbo every two hours, and had neither vomiting, nor purging after the first dose. Nine doses restored him to perfect health.

CASE III. (*c*) April, 1771. Mrs. P——, about the beginning of the third week of her confinement in child-bed, began to complain of great pain, fullness, and uneasiness in the bowels, accompanied with frequent and copious evacuations by stool. What was discharged had the colour and consistence of

(*b*) Communicated by Dr. Haygarth.

(*c*) Communicated by Dr. Dobson.

cream. The pulse was from 100 to 115. The tongue had a whitish fur; and the skin was often dry and hot. The evacuations by stool, and the other symptoms were always much more considerable during the night, than in the day. Ipecacuanha as an emetic, opiates, elixir of vitriol, and other cooling restringents, afforded no relief. A strong infusion of the Columbo-root in cinnamon tea, was then given with the desired effect. After every tea-cup full of the infusion, the patient found herself better; the painful sensations were relieved, and the evacuations diminished. In about five days she was entirely cured.

CASE IV. R. N. Esq. aged 26, the latter end of June 1771, when the weather was extremely hot, was seized with the usual symptoms of a fever. An emetic and gentle cathartic were administered, and saline draughts were directed to be taken at proper intervals. He persisted in this course two or three days, without any sensible relief. A continual nausea, and frequent vomitings of green bile now came on. The skin was hot and dry; the pulse beat an hundred and twenty strokes in a minute; the tongue was foul; the belly not sufficiently soluble, notwithstanding the free use of strawberries, and other fruit was enjoined; and he complained of great pain in his head and back, attended with universal lassitude.

A clyster

A clyster was immediately injected; and two scruples of vitriolated tartar were given every four hours, in three spoonfuls of the infusion of Columbo. The first dose almost instantly alleviated the nausea and sickness, and the continuance of the same remedy entirely prevented their return; whilst the gentle *diarrhœa*, produced by the neutral salt, mitigated all the febrile symptoms. On the eleventh day he had two bloody stools, and as his constitution was feeble and relaxed, the Peruvian bark, combined with astringents, was administered without delay: The hæmorrhage was soon checked, and the patient gradually recovered his usual health and strength.

CASE V. June 2, 1771. Mr. W.'s son, aged two, with other symptoms of dentition, had severe purging and vomiting, which continuing three days, reduced him to the lowest degree of weakness. I directed five grains of Columbo-root, and three grains of *pulv. e chel. c. c.* to be taken every two hours. The vomiting was stopped by the first dose; the looseness was soon after checked; and in two days the child recovered his usual strength.

I SHALL now proceed to relate the experiments which I have made on the Columbo-root.

EXPERIMENT I. Two drachms of Columbo-root, powdered, were infused, without heat, in four ounces of each of the following *menstrua*. 1. Rec-

tified spirit of wine. 2. French brandy. 3. Madeira wine. 4. White wine. 5. Distilled water. 6. White wine vinegar. 7. Hard spring water. After twenty-four hours digestion, the tinctures, &c. were filtered through paper, and equal quantities of each, and of their respective *menstrua* were weighed with great exactness, and compared together. The tincture made with rectified spirit of wine, appeared, by its taste, colour, and superior specific gravity to the simple spirit, to be considerably stronger than the rest; whose degree of impregnation seemed, by these tests, to be exactly in the order in which I have enumerated the several *menstrua* employed in their preparation. It should be remarked, that the watery infusion of Columbo-root is more perishable than that of other bitters. In twenty-four hours a copious precipitation takes place in it, and in two days it becomes ropy, and even musty.

EXPERIMENT II. The addition of orange-peel renders the infusion of Columbo-root less ungrateful to the palate. An ounce of the powdered root, half an ounce of orange-peel, two ounces of French brandy, and fourteen ounces of water, macerated twelve hours without heat, and then filtered through paper, afforded a sufficiently strong, and tolerably pleasant infusion.

EXPERIMENT III. Twelve ounces of Columbo-root, in gross powder, were digested four days

days, in three pints of rectified spirit of wine. The tincture was then filtered, and the *residuum* boiled repeatedly in a sufficient quantity of water, till it yielded no taste to the liquor. The decoctions, having been carefully percolated, were evaporated over a gentle fire, in the common method, till about three quarts only remained. The evaporation was then continued in the vapour bath, and when nearly finished, the tincture, from which a part of the spirit had been previously drawn by the alembic, was gradually added, and the whole reduced to a pilular consistence, retaining the entire flavour of the Columbo, free from the least degree of *empyreuma*, and weighing eight ounces and two drachms. The spirit, distilled from the tincture, was neither impregnated with the taste nor odour of the root; which is a proof that no volatile parts were dissipated by this process. This experiment was made, at my request, by Mr. Henry, an ingenious and accurate Apothecary in Manchester. I have frequently used the extract of Columbo, and find it equal, if not superior, in efficacy to the powder.

EXPERIMENT IV. Equal weights, viz. about two drachms of beef, cut into small pieces, were macerated separately in an ounce of a cold infusion of the Peruvian bark, and of Columbo-root, filtered and prepared in a manner exactly similar. The experiment was made in the month

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of July; the weather was uncommonly warm; and the bottles were placed in a window which had a southern aspect. In forty-eight hours the beef in the infusion of Columbo-root had acquired a slightly putrid foetor, whilst that in the infusion of bark remained perfectly sweet, and continued so ten hours longer. Two drachms of beef, macerated in cold water, and intended for a standard, became putrid in twenty-four hours, under the circumstances above described.

EXPERIMENT V. The putrid beef, employed as a standard in the last experiment, was divided into two equal parts, to one of which was added an ounce of the infusion of Columbo-root; to the other the same quantity of the infusion of Peruvian bark. After six hours maceration, the pieces of flesh had lost much of their putrid foetor; but that in the infusion of Columbo-root, was more offensive than the other.

EXPERIMENT VI. To several phials, each containing three drachms of putrid ox gall, and two drachms of saliva, were added equal quantities, viz. an ounce of, 1. the infusion of Columbo-root; 2. the infusion of Peruvian bark; 3. the infusion of chamomile flowers; 4. spring water: the last was intended as a standard. The phials were placed in a water bath, heated to about one hundred degrees of Fahrenheit's thermometer. When the infusion of bark was mixed with

with the putrid gall and saliva, it instantly produced a coagulation of the gall, and considerably increased the foetor of it. Whereas the infusion of Columbo united perfectly with it, and very powerfully corrected its offensive smell. The infusion of chamomile occasioned no change in the bile, either with respect to its foetor or fluidity. After three hours digestion, the putrid smell of the gall was much abated, in all the phials but the standard, and even in that was less perceptible than at first. In six hours, no foetor could be perceived, except in the standard; and the mixture with the bark had acquired a vinous smell, and emitted many air bubbles. In twelve hours, the odour of the gall was sensible, but not offensive, in the mixtures with Columbo and chamomile: The bark now fermented less, and had lost somewhat of its vinous smell. In twenty-four hours, the standard became extremely putrid; the mixture with bark was sour; the Columbo and chamomile were still sweet; but in thirty hours they became putrid; and in forty hours they were highly offensive.

THE instantaneous effect of the infusion of Columbo, in correcting the putridity of the ox gall, serves in some measure to explain its action in the *cholera morbus*, and other diseases, attended with a redundancy and depravation of the bile: And at the same time it obviates all objection

to the use of this remedy, previous to any artificial evacuations, in the first stage of such disorders, as they occur in hot climates; a practice which, indeed, is justified by its success. The coagulation and increased fœtor of the gall, which the infusion of bark occasioned, very well account for the disagreement of that medicine with the stomach, in the yellow fever of the West-Indies. Doctor Hillary laments that, though strongly indicated, it cannot be retained, even under the pleasantest form. Is it not probable that the Columbo-root, which so readily unites with, and so quickly sweetens putrid bile, would prove very salutary in this dangerous and malignant disease?

EXPERIMENT VII. Equal quantities viz. an ounce, of water, of the infusions of Columbo-root, Peruvian bark, and chamomile flowers, were added to four phials, each containing three drachms of fresh ox gall, and two drachms of saliva. The bottles were then placed at such a distance from the fire, as to be kept blood-warm. In six hours, all the mixtures, except the standard, were in fermentation. The infusion of bark emitted most, and that of Columbo the fewest air bubbles: The former also had acquired a vinous smell. In twenty-four hours, the standard became putrid. In forty-eight hours, the infusion of bark was sour, that of chamomile slightly putrid; but that of Columbo-root was perfectly sweet,

sweet, and continued so many hours afterwards, when the phials were set aside.

N. B. THE infusion of bark, when mixed with the recent gall, produced a coagulation, but not in so great a degree as when combined with putrid bile.

SIR JOHN PRINGLE found that chamomile flowers resist the putrefaction of animal flesh, more powerfully than Jesuit's bark; and from one of the preceding experiments, it appears that, in this respect, bark is more antiseptic than Columbo-root. But as a preservative of the *bile* from putridity, this root surpasses *chamomile flowers*, without producing, like the bark, any changes in it by fermentation. Hence may be justly inferred the utility of Columbo-root in disorders of a putrid tendency, and in an impaired digestion, from corrupted bile, or vitiated and unsound saliva.

EXPERIMENT VIII. To determine the comparative action of Columbo-root on the fermentation of food in the stomach, I digested, in the water bath, three alimentary mixtures, prepared of two drachms of the crumb of bread; the same quantity of roasted mutton, chopped very small; and an ounce of the infusions of Columbo-root, chamomile flowers, and mustard seed. The ingredients of each mixture were well united by triture, in a mortar; and a fourth phial was pro-

vided as a standard, which contained the proportions before mentioned of bread and mutton, with half an ounce of water, and the same quantity of saliva. In twelve hours, the standard began to ferment; in thirty hours, an intestine motion was perceptible in the other mixtures, but appeared to be least in the phial which contained the Columbo-root. In forty-eight hours, the standard became sour. The third day, the mixture with the infusion of chamomile was also sour. The two remaining phials, viz. the infusions of Columbo and of mustard, were now placed by the fire, where they continued ten days, without shewing the least signs either of acidity, or of putrefaction.

THE resemblance between the taste of mustard and of Columbo-root induced me to try their comparative action on alimentary fermentation. And it appears they concur in moderating, without suspending, the process of digestion. This property gives Columbo-root the advantage over other bitters, in such disorders of the stomach, as are attended with a violent fermentation of the food, with flatulence, and great acidity. And if a stimulus be wanting to excite this organ to a quicker expulsion of its contents, some grateful aromatic may be combined with it: Or perhaps mustard-seed would equally answer this intention, without increasing, like the spices, the generation of air. This experiment proves the remarkable

able efficacy of the Columbo in preventing acidities; and the succeeding one no less clearly evinces its power of neutralizing them.

EXPERIMENT IX. To an ounce of the infusions of chamomile flowers, of Columbo-root, and of Peruvian bark, were added twenty drops of vinegar. The infusion of Columbo entirely neutralized the acid, that of chamomile flowers in some measure covered the taste of it; but the infusion of bark was evidently sour, both to the taste and smell, and it required twenty drops more of vinegar, to render the infusion of Columbo equally acidulous with that of the bark.

EXPERIMENT X. & XI. To ascertain the action of Columbo-root on the heart and arteries, I took a scruple of the powder, in a small glass of spring water, at seven o'clock in the evening. My stomach was empty; I had been sitting at rest an hour; and my pulse then beat seventy-four strokes in a minute. I continued to sit still half an hour longer, and, every fifth minute, examined my pulse; but could perceive no variation, either in its regularity, fullness, or velocity. The succeeding evening, I repeated the same experiment, with the precautions I had before observed, and increased the dose of Columbo to half a drachm. At the time I swallowed the powder, my pulse beat eighty strokes in a minute; in ten minutes it became fuller, and slower by three strokes, and

continued

continued to beat the same number, viz. seventy-seven, for three quarters of an hour.

THESE experiments shew that the Columbo-root does not belong to the class of heating bitters: It may therefore be used with propriety and advantage in the *phthisis pulmonalis*, and in hectic cases, to correct acrimony, and strengthen the organs of digestion. The Peruvian bark often proves oppressive to the stomach in such disorders, and sometimes excites a *diarrhœa*. But the Columbo-root occasions no disturbance, and agrees very well with a milk diet, as it abates flatulence, and is indisposed to acidity.

P. S. 1776. THE efficacy of the Columbo root, in a variety of disorders, has now been experienced by the public; and it affords me great satisfaction, that I have been instrumental, in exciting the attention of Physicians to a remedy of such acknowledged utility. But the high price which this root bears, the general demand for it, and the small quantity that now remains in England, will occasion such adulteration, as may prove very injurious to its reputation. Besides,
the

the bitterness of the Columbo is much impaired by keeping; it is liable to rot, and to become worm eaten; and from these causes it may lose all its medicinal virtues. I have seen many specimens of it, which must fail, when administered, to answer the views of the prescriber. Whether we are likely to obtain any sufficient supplies of this remedy, I am uncertain. Applications have been made to the captains of several ships, bound to India; but our ignorance of the natural history of the root is a great obstacle to the acquisition of it. The practitioners of physic in the East Indies cannot, without danger, prosecute botanical researches, in a climate where all nature swarms with life. And they employ the natives of the country to collect their simples; whose interest it is to conceal the manner of their production, and their places of growth. Mr. Ives, in his voyage to India, mentions the Columbo-root in the following terms, page 482. “*Radix Indica* “*Amara*. This is the root of the *Cocculus* “*Indicus*. When quite fresh it is an emetic; “when dry a cathartic.” These characters are so opposite to the known qualities of the Columbo-root, that I apprehend Mr. Ives must be mistaken in his account. And I have desired Doctor Lind, of Haslar hospital, who is personally acquainted with that gentleman, to make farther inquiries of him, concerning the *Cocculus Indicus*.

Indicus. The Doctor has executed my commission, with the most obliging and friendly attention. But he has not been able to obtain, either from Mr. Ives, or from Mr. Bogue, who had the charge of the naval hospital in India, and who is lately returned from thence, any satisfactory information.

E S S A Y II.

O N T H E

PREPARATION, CULTURE, AND USE

O F T H E

O R C H I S R O O T (a).

SALEP is a preparation of the root of Orchis, or Dogstones, of which many species are enumerated by Botanical writers. The *Orchis mascula*, Linn. *sp. pl.* is the most valued, though the roots of some of the palmated sorts, particularly of the *Orchis latifolia*, are found to answer almost equally well. This plant flourishes in various parts of Europe and Asia, and grows in our country spontaneously, and in great abundance. It is assiduously cultivated in the East; and the root of it forms a considerable part of the diet of the inhabitants of Turkey, Persia, and Syria. A dry and not very fertile soil is best adapted to its growth. An ingenious friend of mine, in order to collect the seed, transplanted

(a) Inserted in the Georgical Essays, published by Dr. Hunter, of York.

a number

a number of the Orchises into a meadow, where he had prepared a bed well manured for their reception. The next spring few of them appeared, and not one came to maturity, their roots being black and half rotten. The same gentleman informed me, that he had never been able to raise any plant from the seed of the wild Orchis; but he ascribes his want of success to the wetness of the situation, in which he resides. I have now before me a seed pod of the Orchis, the contents of which, to the naked eye, seem to be seed corrupted and turned to dust, but, when viewed through a microscope, appear evidently to be organized, and would, I doubt not, with proper culture germinate, and produce a thriving crop of plants. The properest time for gathering the roots is when the seed is formed, and the stalk is ready to fall, because the new bulb, of which the Salep is made, is then arrived at its full maturity, and may be distinguished from the old one, by a white bud rising from the top of it, which is the germ of the Orchis of the succeeding year.

SEVERAL methods of preparing Salep have been proposed and practised. Geoffroy has delivered a very judicious process for this purpose, in the *Histoire de l'Academie Royale des Sciences* 1740; and Retzius, in the *Swedish Transactions* 1764, has improved Geoffroy's method. But Mr. Moulton, of Rochdale, has lately favoured the public with a

new

new manner of curing the Orchis root; and as I have seen many specimens of his Salep, at least equal, if not superior to any brought from the Levant, I can recommend the following, which is his process, from my own knowledge of its success. The new root is to be washed in water, and the fine brown skin, which covers it, is to be separated by means of a small brush, or by dipping the root in hot water, and rubbing it with a coarse linen cloth. When a sufficient number of roots have been thus cleaned, they are to be spread on a tin plate, and placed in an oven, heated to the usual degree, where they are to remain six or ten minutes, in which time they will have lost their milky whiteness, and acquired a transparency like horn, without any diminution of bulk. Being arrived at this state, they are to be removed, in order to dry and harden in the air, which will require several days to effect; or by using a very gentle heat, they may be finished in a few hours(*b*).

SALEP thus prepared, may be afforded in this part of England, where labour bears a high value, at about eight-pence or ten-pence per pound. And it might be sold still cheaper, if the Orchis were to be cured, without separating from it the brown skin which covers it; a troublesome part

(*b*) See a Letter from Mr. John Moulton to the Author, containing a new method of preparing Salep; inserted in the LIX. vol. of the Phil. Transactions.

of the process, and which does not contribute to render the root, either more palatable or salutary. Whereas the foreign Salep is now sold at five or six shillings per pound.

THE culture of the Orchis, therefore, is an object highly deserving of encouragement, from all the lovers of agriculture. And as the root, if introduced into common use, would furnish a cheap, wholesome, and most nutritious article of diet, the growth of it might be sufficiently profitable to the farmer.

SALEP is said to contain the greatest quantity of vegetable nourishment, in the smallest bulk. Hence a very judicious writer, to prevent the dreadful calamity of famine at sea, has lately proposed that the powder of it should constitute part of the provisions of every ship's company. This powder and portable soup, dissolved in boiling water, form a rich thick jelly, capable of supporting life for a considerable length of time. An ounce of each of these articles, with two quarts of boiling water, will be sufficient subsistence for a man, in a day (*c*); and as being a mixture of animal and vegetable food, must prove more nourishing

(*c*) Portable soup is sold at half a crown per pound; Salep, if cultivated in our own country, might be afforded at ten-pence per pound; the day's subsistence would, therefore, amount only to two-pence halfpenny.

than double the quantity of rice cake, made by boiling rice in water : This last, however, sailors are often obliged solely to subsist upon for several months, especially in voyages to Guinea, when the bread and flour are exhausted, and the beef and pork, having been salted in hot countries, are become unfit for use (*d*).

BUT as a wholesome nourishment, rice is much inferior to Salep. I digested several alimentary mixtures prepared of mutton and water, beat up with bread, sea biscuit, Salep, rice flour, sago powder, potatoe, old cheese, &c. in a heat equal to that of the human body. In forty-eight hours they had all acquired a vinous smell, and were in brisk fermentation, except the mixture with rice, which did not emit many air bubbles, and was but little changed. The third day, several of the mixtures were sweet, and continued to ferment; others had lost their intestine motion, and were sour; but the one which contained the rice was become putrid. From this experiment it appears that rice, as an aliment, is slow of fermentation, and a very weak corrector of putrefaction. It is therefore an improper diet for hospital patients; but more particularly for sailors, in long voyages, because it is incapable of preventing, and will not contribute much to check the progress of that

(*d*) Vid. Dr. Lind's Appendix to his Essay on the Diseases of Hot Climates.

fatal disease, the sea scurvy. Under certain circumstances, rice seems disposed of itself, without mixture, to become putrid. For by long keeping it sometimes acquires an offensive foetor. Nor can it be considered as a very nutritive kind of food, on account of its difficult solubility in the stomach. Experience confirms the truth of this conclusion; for it is observed by the planters in the West-Indies, that the negroes grow thin, and are less able to work, whilst they subsist upon rice.

SALEP has the singular property of concealing the taste of salt water (*e*); a circumstance of the highest importance at sea, when there is a scarcity of fresh water. I dissolved a drachm and a half of common salt in a pint of the mucilage of Salep, so liquid as to be potable, and the same quantity in a pint of spring water. The Salep was by no means disagreeable to the taste, but the water was rendered extremely unpalatable.

THIS experiment suggested to me the trial of the Orchis root, as a corrector of acidity, a property which would render it a very useful diet for children. But the solution of it, when mixed with vinegar, seemed only to dilute, like an equal proportion of water, and not to cover its sharpness.

SALEP however appears, by my experiments, to retard the acetous fermentation of milk, and

(*e*) Vid. Dr. Lind's Appendix.

consequently

consequently would be a good lithing for milk pottage, especially in large towns, where the cattle being fed upon four draff, must yield acfcent milk.

SALEP, in a certain proportion, which I have not yet been able to ascertain, would be a very useful and profitable addition to bread. I directed one ounce of the powder to be dissolved in a quart of water, and the mucilage to be mixed with a sufficient quantity of flour, salt, and yeast. The flour amounted to two pounds, the yeast to two ounces, and the salt to eighty grains. The loaf, when baked, was remarkably well fermented, and weighed three pounds, two ounces. Another loaf, made with the same quantity of flour, &c. weighed two pounds and twelve ounces; from which it appears, that the Salep, though used in so small a proportion, increased the gravity of the loaf six ounces, by absorbing and retaining more water than the flour alone was capable of. Half a pound of flour, and an ounce of Salep were mixed together, and the water added according to the usual method of preparing bread. The loaf, when baked, weighed thirteen ounces and a half; and would probably have been heavier, if the Salep had been previously dissolved in about a pint of water. But it should be remarked, that the quantity of flour used in this trial was not sufficient to conceal the peculiar taste of the Salep.

The restorative, mucilaginous, and demulcent qualities of the Orchis root render it of considerable use in various diseases. In the sea scurvy, it powerfully obtunds the acrimony of the fluids, and at the same time is easily assimilated into a mild and nutritious chyle. In diarrhœas and the dysentery, it is highly serviceable, by sheathing the internal coat of the intestines, by abating irritation, and gently correcting putrefaction. In the symptomatic fever, which arises from the absorption of pus, from ulcers in the lungs, from wounds, or from amputation, Salep, used plentifully, is an admirable demulcent, and well adapted to resist that dissolution of the *crasis* of the blood, which is so evident in these cases. And by the same mucilaginous quality, it is equally efficacious in the strangury, and dysury; especially in the latter, when arising from a venereal cause; as the discharge of urine is then attended with the most exquisite pain, from the ulcerations about the neck of the bladder, and through the course of the *urethra*. I have found it also an useful aliment for patients who labour under the stone or gravel (*f*).

FROM

(*f*) THE ancient chemists seem to have entertained a very high opinion of the virtues of the Orchis root, of which the following quotation from the *SECRETA SECRETORUM* of Raymund Lully, affords a diverting proof. The work is dated 1565; and is here copied, I believe, *verbatim*.

SEXTA

FROM these observations, short and imperfect as they are, I hope it will sufficiently appear that the culture of the Orchis root is an object of considerable importance to the public, and highly worthy of encouragement from all the patrons of agriculture. That taste for experiment, which characterizes the present age, and which has so amazingly enlarged the boundaries of science, now animates the RATIONAL FARMER, who fears not to deviate from the beaten track, whenever improvements are suggested, or useful projects are pointed out to him. Much has been already done for the advancement of agriculture; but

S E X T A H E R B A,

S A T I R I O N.

“ SATIRION herba est pluribus nota, hujus radicis collecta ad pondus lib. 4. die 20 mensis Januarij, contunde fortiter & massam contusam pone in ollam de aurichalcum habente in cooperculo 20 foramina minuta sicut athomi, & pone intus cum prædicta massa lactis vaccini calidi sicut mulgetur de vacca ℥. 3. & mellis libram 1. vini aromatici ℥. 2. & repone per dies 20. ad solem & conserua & utere.”

“ Istius itaq; dosis ad pondus 3. 4. & hora diei decima exhibita mulieri post ipsius menstrua eadem nocte cōcipiet si vir cum ea agat.”

the earth still teems with treasures, which remain to be explored. The bounties of nature are inexhaustible, and will for ever employ the art, and reward the industry of man(g).

(g) In 1773 the Society for the Encouragement of Arts, Manufactures, and Commerce was, I believe, induced by it to offer a premium for the culture of the Orchis root, and the preparation of Salep.

E S S A Y III.

EXPERIMENTS AND OBSERVATIONS ON THE

W A T E R S

OF

BUXTON AND MATLOCK,

IN DERBYSHIRE (*b*).

SECTION I.

ON BUXTON WATER.

THE water of St. Ann's well at BUXTON is found, by analysis, to contain calcareous earth, fossil alkali, and sea salt; but in very small proportions. For a gallon of the water, when evaporated, yields only twenty-three or twenty-four grains of sediment. It strikes a slight green colour with syrup of violets; suffers no change from an infusion of galls, from the fixed vegetable alkali, or from the mineral acids; becomes milky with the volatile alkali, and with *saccharum saturni*; and lets fall a precipitate, on the addition

(*b*) Inserted in the *Philos. Trans.* vol. LXII. p. 455.

of a few drops of a solution of silver, in the nitrous acid. The specific gravity of this water is precisely equal to that of rain water, when their temperatures are the same; but it weighs four grains in a pint lighter, when first taken from the spring. The temperature of the bath is about 82 degrees of Fahrenheit's thermometer; that of St. Ann's well, as it is a smaller body of water, and exposed to the open air, is somewhat less. The water is transparent, sparkling, and highly grateful to the palate (*i*).

IN October 1769, I passed a few days at Buxton; and, during my stay there, amused myself with the following experiments on the effects of the water of St. Ann's well on my pulse.

EXPERIMENT I. October 12th. Eight o'clock in the morning. The day cold and moist. My pulse beat 84 strokes in a minute. I drank at the well a third of a pint of water, and using every necessary precaution, examined my pulse at certain intervals of time. In five minutes, pulse 80. In ten minutes, pulse 80, fuller and harder. In twenty minutes, pulse 85. In half an hour, pulse 90.

EXPERIMENT II. Eleven o'clock *a. m.* Two hours after breakfast. The air warm and serene.

(*i*) I AM indebted to the information of Dr. Bullock, the physician who attends at Buxton, for some of these facts.

Pulse

Pulse 90. I repeated the draught of water. In seven minutes, pulse 109. In fifteen minutes, pulse 103. In thirty minutes, pulse 100. Head ach. In an hour and a half, pulse 95. Head ach abated.

EXPERIMENT III. October 13th. Eight o'clock in the morning. The day cold. Pulse 92. I drank the quantity of water above mentioned. In five minutes, pulse 86. In fifteen minutes, pulse 86, full and hard. In twenty minutes, pulse 100. In half an hour, pulse 92.

FROM the first and third experiments, it appears that the coldness of the morning counteracted, for a time, the effects of the Buxton water, and reduced the vibrations of my pulse from 84 to 80, and from 92 to 86. But the stimulus of the water soon became superior to the sedative powers of the cold, to which I was exposed; for within the space of half an hour, my pulse rose to 90 in the first, and to 100 strokes in the second trial. At eleven o'clock before noon, when the air was warm and serene, the water in a much shorter time exerted its full force, increasing the velocity of my pulse from 90 to 109 vibrations in a minute.

THESE experiments evince the heating quality of Buxton water, and suggest to us the precautions to be observed in the use of it. Small quantities only should be drunk at once, and frequently

frequently repeated; the bowels should be kept soluble with lenitive electuary, or any other mild purgative; and at the beginning of the course, the patient may be directed to suffer the water to remain a few seconds in the glass, before he swallows it. For this celebrated spring abounds with a mineral spirit, in which its stimulus, and indeed its efficacy resides, and which is quickly dissipated by exposure to the air.

THE Hon^{ble}. and ingenious Mr. Cavendish has shewn, by his Experiments on Rathbone-place water, Philof. Transact. vol. LVII. that calcareous earths may be rendered soluble in water, by furnishing them with more than their natural proportion of fixed air. And it has lately been discovered that iron, also, may be suspended by this principle, in the same *menstruum* (*k*). It appeared, therefore, highly probable to me, that a chalybeate impregnation might, with great facility, be communicated to the Buxton water, when fresh drawn from the spring; a quality which in many cases would add greatly to its medicinal efficacy. I suggested the trial to Mr. Buxton, a worthy and sensible Apothecary near the wells, who has lately, at my request, made the following experiment.

(*k*) Vid. Mr. Lane's Experiments, Phil. Transf. vol. LIX.

EXPERIMENT IV. A quart bottle, containing two drachms of iron filings, was filled by immersion, with the water of St. Ann's well, corked and agitated briskly under the surface of the water. It was then suffered to remain in the well till the filings had subsided, when the water was carefully decanted into a half pint glass. To this were added three drops of the tincture of galls, which immediately occasioned a deep purple colour; and the transparency was presently restored by a few drops of the acid of vitriol; evident proofs that the solution of the iron was effected in a few minutes. The water also, without the tincture of galls, had a chalybeate taste, and left an agreeable astringency upon the palate.

By this experiment it appears that a warm chalybeate, abounding with a mineral spirit, and grateful to the taste, may with very little trouble be obtained. And this method of impregnating the Buxton water with iron must increase its tonic powers, and in many cases improve its medicinal virtues. It is a common practice to join the use of a chalybeate spring, in the neighbourhood of St. Ann's well, with that of the Buxton water. But the superiority of this artificial mineral water must be apparent, if we consider its agreeable warmth, volatility, levity, and gratefulness to the palate.

Buxton bath is very frequently employed as a temperate cold bath. For as the heat of the water is sixteen or eighteen degrees below that of the human body, a gentle shock is produced on the first immersion, the heart and arteries are made to contract more powerfully, and the whole system is braced and invigorated. But this salutary operation must be greatly diminished, often indeed more than counterbalanced, by the relaxing vapours which copiously exhale from the bath, to which the patients are exposed during the time of dressing and undressing. A separate room is indeed provided for the ladies; but the gentlemen have no other accommodations than what the vault affords, in which the bath is contained, and are therefore liable to all the inconveniences which arise from warmth and moisture.

June 12, 1772. THE mercury in Fahrenheit's thermometer stood in the shade at 65; but in this vault quickly rose to 78 degrees.

SECTION II.

O N

MATLOCK WATER.

EXPERIMENT I. **A** Thermometer, made by Dollond, and graduated according to Fahrenheit's scale, was exposed for a sufficient length of time to the stream of water, as it gushes out of the rock, and also immersed in the basin which receives it. The mercury rose to 66 degrees.

EXPERIMENT II. Six drops of *sp. sal. ammon. vol.* were poured into a glass of the spring water, which contained about the sixth of a pint; a very slight cloudiness immediately ensued; but no precipitation was afterwards observable.

EXPERIMENT III. Six drops of a solution of salt of tartar occasioned a cloudiness just perceptible, in the same quantity of water. No precipitation ensued.

EXPERIMENT IV. Six drops of a solution of *saccharum saturni* immediately produced a milkiness in the water, but no sensible precipitation.

EXPERIMENT V. Six drops of a solution of silver in the nitrous acid instantly occasioned a milkiness

a milkiness in the water : And after standing an hour, a grey powder was observable at the bottom of the glass.

EXPERIMENT VI. Ten drops of the infusion of galls neither produced any change of colour in the water, at the time they were added, nor was the slightest purple hue perceptible two hours afterwards.

EXPERIMENT VII. A piece of paper, besmeared with fresh syrup of violets, was dipped into a glass full of water. No change of colour ensued.

EXPERIMENT VIII. Another piece of paper, moistened in the same manner with the syrup, was placed over a glass of water, as soon as it was taken from the spring. The paper suffered no change of colour, although it remained an hour upon the glass.

EXPERIMENT IX. My pulse beat 84 strokes in a minute, at the time when I drank a half pint glass of the Matlock water. In twenty minutes my pulse rose to 88. In half an hour they sunk to 82 ; and continued to vibrate the same number of times for an hour, which was as long as I thought it necessary to examine them.

EXPERIMENT X. The mercury in Fahrenheit's thermometer, when immersed in each of the baths, stood at 68 ; in the river Derwent, which flows through the valley of Matlock, at 52.

These

These experiments were made on the 12th of June 1772, and the weather was warm.

EXPERIMENT XI. A four ounce phial, after being accurately counterpoised in a very nice balance, was filled to the brim with distilled water, which weighed three ounces, four drachms, forty-five grains and a half. The same phial, exactly balanced as before, was then filled to the brim with Matlock water, of the same temperature with the distilled water, which weighed three ounces, four drachms, and forty-six grains.

MATLOCK water is grateful to the palate, and of an agreeable warmth, but exhibits no marks of mineral spirit, either by its taste, sparkling appearance in the glass, or by the chemical test employed in experiment VIII. The second and third experiments shew, that it is very slightly impregnated with selenites or other earthy salts; and of this its comparative levity affords also a further proof. For it weighs twenty-six grains in a pint lighter than the Manchester pump water; and only four grains heavier than distilled water. The precipitation of a grey powder, by the addition of a solution of silver in *aqua fortis* to the water, renders it probable that a small portion of sea salt is contained in it. For the powder is found to consist of the particles of silver combined with the muriatic acid, which is separated from the fossil alkali by the superior affinity the nitrous acid

acid bears to it; and thus a double elective attraction takes place in this experiment.

THIS water has been said to contain iron. But the assertion is at least rendered doubtful by the sixth experiment, which was made with the utmost accuracy; and I am inclined to think that it is entirely without foundation. The spring is justly celebrated for its efficacy in hæmoptoes; and hence it may have been too hastily concluded that it possesses some slight degree of stypticity, by means of a chalybeate impregnation.

THE ninth experiment affords a presumption, that the water is not possessed of any stimulating powers. For the small increase of quickness in my pulse, on drinking half a pint of it, may be ascribed more to the quantity received into the stomach, than to the heating quality of the water.

THE Bristol and Matlock waters appear to resemble each other, both in their chemical and medicinal qualities. I have examined and compared them together by the tests mentioned above; and so far as such trials may be deemed conclusive, there seems to be no other than the following slight difference between them. The Bristol water becomes a little more milky, on the addition of a solution of fixed alkali, and of *saccharum saturni*, than that of Matlock. The former, also, weighs near a grain in a pint heavier than the latter. Is it not to be lamented, therefore,
that

that so little attention is paid to Matlock, even by the physicians who reside in the neighbourhood of it? In hectic cases, hæmoptoes, the diabetes, and other disorders, in which the circulation of the blood is rapid and irregular, Matlock water, on some accounts, claims the preference to that of Bristol. For as it is not sensibly impregnated with any mineral spirit, it should seem to be less disposed to quicken the pulse, and may therefore be drunk in larger quantities. But it must be acknowledged that the climate of Bristol is superior to that of Matlock; a circumstance of the highest importance to consumptive patients. In this deep, though delightful valley, surrounded by very high mountains, the sun disappears earlier in the evening, the fogs are longer in dispersing, and it may be presumed that rain falls here more frequently and copiously, than in other places. For at Chatsworth, which is encompassed also with hills, and is about ten miles distant, in 1764, 1765, 1767, and 1768, about thirty-three inches of rain, at a medium, fell each year.

THE following Table exhibits a comparative view of the different temperatures of Bath, Buxton, Bristol, and Matlock waters, measured by Fahrenheit's thermometer.

BATH (*f*).

King's Bath Pump	-	-	-	112°.
Hot Bath Pump	-	-	-	114 $\frac{1}{2}$ °.
Crofs Bath Pump	-	-	-	110.

BRISTOL (*f*).

Hot Well Pump	-	-	-	76.
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BUXTON.

Bath	-	-	-	82.
St. Ann's Well	-	-	-	81°.

MATLOCK.

Baths	-	-	-	68.
Spring	-	-	-	66.

(*f*) *Vid.* Mr. Canton's Experiments, Philosophical Transactions, vol. LVII. p. 203.

E S S A Y IV.

OBSERVATIONS ON THE

M E D I C I N A L U S E S

O F

F I X E D A I R (*a*).

IN a course of Experiments, which is yet unfinished, I have had frequent opportunities of observing that FIXED AIR may, in no inconsiderable quantity, be breathed without danger or uneasiness. And it is a confirmation of this conclusion, that at Bath, where the waters copiously exhale a mineral spirit (*b*), the bathers inspire it with impunity. At Buxton also, where the bath is in a close vault, the effects of such *effluvia*, if noxious, must certainly be perceived.

ENCOURAGED by these considerations, and still more by the testimony of a very judicious physician

(*a*) INSERTED in the Appendix to Dr. Priestley's Experiments and Observations on Air, vol. I. p. 300.

(*b*) SEE Dr. Falconer's very useful and ingenious Treatise on the Bath Water, second edit. p. 313.

at Stafford, in favour of this powerful antiseptic remedy, I have administered fixed air, in a considerable number of cases of the PHTHISIS PULMONALIS, by directing my patients to inspire the steams of an effervescing mixture of chalk and vinegar; or, which I have lately preferred, of vinegar and pot-ash. The hectic fever has, in several instances, been greatly abated; and the matter expectorated has become less offensive, and better digested. I have not yet, however, been so fortunate, in any one case, as to effect a cure; although the use of mephitic air has been accompanied with proper internal medicines. But Dr. Withering, the gentleman referred to above, informs me that he has been more successful. One phthical patient under his care has, by a similar course, entirely recovered; another was rendered much better; and a third, whose case was truly deplorable, seemed to be kept alive by it more than two months (c). It may be proper to observe

(c) IN a Treatise on the FOXGLOVE, published in 1785, Dr. WITHERING has inserted the following note. “Many years ago, I communicated to my friend, Dr. Percival, an account of some trials of breathing FIXED AIR, in CONSUMPTIVE CASES. The results were published by him, in the second volume of his *Essays Medical and Experimental*, and have since been copied into other publications. I take this opportunity of acknowledging, that I suspect myself to have been mistaken, in the nature of the disease, there mentioned to have been cured.

“ I believe

observe that fixed air seems only to be indicated in the latter stages of the *phthisis pulmonalis*, when a purulent expectoration takes place. After the rupture and discharge of a *VOMICA* also, such a remedy promises to be a powerful palliative. Antiseptic fumigations and vapours have been long employed, and much extolled in cases of this kind. I made the following experiment, to determine whether their efficacy, in any degree, depends on the separation of fixed air from their substance.

ONE end of a bent tube was fixed in a phial full of lime water; the other end in a bottle of the tincture of myrrh. The junctures were carefully luted, and the phial, containing the tincture of myrrh, was placed in water heated almost to the boiling point, by the lamp of a tea-kettle. A number of air bubbles were separated but probably not of the mephitic kind: For no precipitation ensued in the lime-water. This experiment was repeated with the *Tinct. Tolutana*, *Ph. Ed.* and with *Sp. Vinos. Camph.* and the result was entirely the same. The medicinal action, there-

“ I believe it was a case of *Vomica*, and not a true
 “ *Phthisis*, that was cured. The *Vomica* is almost always
 “ curable. The fixed air corrects the smell of the matter,
 “ and very shortly removes the hectic fever. My pati-
 “ ents not only inspire it, but I keep large jars of the
 “ effervescing mixture constantly at work, in their
 “ chambers.” See Withering on the Foxglove, p. 205.

fore, of the vapours raised from such tinctures, cannot be ascribed to the extrication of fixed air; of which it is probable bodies are deprived by *chemical solution*, as well as by *mixture*.

If mephitic air be thus capable of correcting purulent matter in the lungs, we may reasonably infer it will be equally useful, when applied externally to foul ULCERS. And experience confirms the conclusion. Even the sanies of a CANCER, when the carrot poultice failed, has been sweetened by it, the pain mitigated, and a better digestion produced. The cases I refer to are now in the Manchester infirmary, under the direction of my friend Mr. White, whose skill as a surgeon, and abilities as a writer are well known to the public.

Two months have elapsed since these observations were written (*d*), and the same remedy, during that period, has been assiduously applied, but without any further success. The progress of the cancers seems to be checked by the fixed air; but it is to be feared that a cure will not be effected. A palliative remedy, however, in a disease so desperate and loathsome, may be considered as a very valuable acquisition. Perhaps NITROUS AIR might be still more efficacious. This species of factitious air is obtained from all the metals except zinc, by means of nitrous acid;

(*d*) May, 1772.

and

and Dr. Priestley informs me, that, as a sweetener and antiseptic, it far surpasses fixed air. He put two mice into a quantity of it, one just killed, the other offensively putrid. After twenty-five days, they were both perfectly sweet.

IN the ULCEROUS SORE THROAT, much advantage has been experienced from the vapours of effervescing mixtures drawn into the *fauces*. But this remedy should not supersede the use of other antiseptic applications.

A PHYSICIAN, who had a painful APTHOUS ULCER at the point of his tongue, found great relief, when other remedies failed, from the application of fixed air to the part affected. He held his tongue over an effervescing mixture of pot-ash and vinegar; and as the pain was always mitigated, and generally removed by this vaporization, he repeated it, whenever the anguish arising from the ulcer was more than usually severe. He tried a combination of pot-ash and oil of vitriol, well diluted with water; but this proved stimulant, and increased his pain; probably owing to some particles of the acid thrown upon the tongue, by the violence of the effervescence. For a paper, stained with the purple juice of radishes, when held at an equal distance over two vessels, the one containing pot-ash and vinegar, the other the same alkali and *Spiritus Vitrioli tenuis*, was unchanged by the former,

but was spotted with red, in various parts, by the latter.

IN MALIGNANT FEVERS, wines abounding with fixed air may be administered, to check the septic ferment, and sweeten the putrid *colluvies* in the *primæ viæ*. If the laxative quality of such liquors be thought an objection to the use of them, wines of a greater age may be given, impregnated with mephitic air, by a simple, but ingenious contrivance of Dr. Priestley (*e*).

THE patient's common drink might also be medicated in the same way. A putrid DIARRHOEA frequently occurs, in the latter stages of such disorders; and it is a most alarming and dangerous symptom. If the discharge be stopped by astringents, a putrid *fomes* is retained in the body, which aggravates the delirium, and increases the fever. On the contrary, if it be suffered to take its course, the strength of the patient, must soon be exhausted, and death unavoidably ensue. The injection of mephitic air into the intestines, under these circumstances, bids fair to be highly serviceable. And a case, of this deplorable kind, has lately been communicated to me, in which the vapour of chalk and oil of vitriol, conveyed into the body by the

(*e*) Directions for impregnating water with fixed air, in order to communicate to it the peculiar spirit and virtues of Pyrmont water, and other mineral waters of a similar nature.

machine

machine employed for tobacco clysters, quickly restrained the *diarrhœa*, corrected the heat and foetor of the stools, and in two days removed every symptom of danger*. A similar instance of the salutary effects of mephitic air, thus administered, has occurred, also, in my own practice, the history of which I shall briefly lay before the reader. May we not presume that the same remedy would be equally useful in the DYSENTERY? The experiment is at least worthy of trial.

ELIZABETH GRUNDY, aged seventeen, was attacked on the 10th of December 1772, with the usual symptoms of a continued fever. The common method of cure was pursued; but the disease increased, and soon assumed a putrid type.

On the 23d, I found her in a constant delirium, with a *subsultus tendinum*. Her skin was hot and dry, her tongue black, her thirst immoderate, and her stools frequent, extremely offensive, and for the most part involuntary. Her pulse beat 130 strokes in a minute; she dozed much; and was very deaf. I directed wine to be administered freely; a blister to be applied to her back; the *pediluvium* to be used several times in the day; and mephitic air to be injected, under the form of a clyster every two hours. The next day, her stools were less frequent, had lost their foetor, and

* See a case by Mr. Hey of Leeds, in the Appendix to Dr. Priestley's Observations on Air, vol. I.

were no longer discharged involuntarily; her pulse was reduced to 110 strokes in the minute; and her delirium was much abated. Directions were given to repeat the clysters, and to supply the patient liberally with wine. These means were assiduously pursued several days; and the young woman was so recruited by the 28th, that the injections were discontinued. She was now quite rational, and not averse to medicine. A decoction of Peruvian bark was, therefore, prescribed, by the use of which she speedily recovered her health.

I MIGHT add another history of a putrid disease, in which the mephitic air is now under trial, and which affords the strongest proof both of the *antiseptic*, and of the *tonic* powers of this remedy; but as the issue of the case remains yet undetermined, (though it is highly probable, alas! that it will be fatal) I shall relate only a few particulars of it. Master D. a boy of about twelve years of age, endowed with an uncommon capacity, and with the most amiable dispositions, has laboured many months under a hectic fever, the consequence of several tumours in different parts of his body. Two of these tumours were laid open by Mr. White, and a large quantity of purulent matter was discharged from them. The wounds were very properly treated by this skilful surgeon, and every remedy, which my best judgment could suggest,

suggest, was assiduously administered. But the matter became sanious, of a brown colour, and highly putrid. A *diarrhœa* succeeded; the patient's stools were intolerably offensive, and voided without his knowledge. A black fur collected about his teeth; his tongue was covered with *aphthæ*; and his breath was so foetid, as scarcely to be endured. His strength was almost exhausted; a *subfultus tendinum* came on; and the final period of his sufferings seemed to be rapidly approaching. As a last, but almost hopeless effort, I advised the injection of clysters of mephitic air. These soon corrected the foetor of the patient's stools, restrained his *diarrhœa*; and seemed to recruit his strength and spirits. Within the space of twenty-four hours, his wounds assumed a more favourable appearance; the matter discharged from them became of a better colour and consistence; and was no longer so offensive to the smell. The use of this remedy has been continued several days, but is now laid aside. A large tumour is suddenly formed under the right ear; swallowing is rendered difficult and painful; and the patient refuses all food and medicine. Nourishing clysters are directed: But it is to be feared that these will renew the looseness, and that this amiable youth will quickly sink under his disorder (*f*).

(*f*) He languished about a week, and then died.

THE use of *Wort*, from its saccharine quality, and disposition to ferment, has lately been proposed as a remedy for the SEA SCURVY. Water, or other liquors, already abounding with fixed air in a separate state, should seem to be better adapted to this purpose; as they will more quickly correct the putrid disposition of the fluids, and at the same time, by their gentle stimulus(g), increase the powers of digestion, and give new strength to the whole system.

DR. PRIESTLEY, who suggested both the idea and the means of executing it, has, under the sanction of the College of Physicians, proposed the scheme to the Lords of the Admiralty, who have ordered trial to be made of it, on board some of his Majesty's ships of war. Might it not, however, give additional efficacy to this remedy, if, instead of simple water, the infusion of malt were to be employed?

I am persuaded such a medicinal drink might be prescribed also, with great advantage, in SCROPHULOUS COMPLAINTS, when not attended with a hectic fever; and in other disorders, in which a general acrimony prevails, and the crasis of the blood is destroyed. Under such circum-

(g) The vegetables, which are most efficacious in the cure of the scurvy, possess some degree of stimulating power.

stances,

stances, I have seen *vibices*, which spread over the body, disappear in a few days from the use of wort.

A GENTLEMAN, who is subject to a scorbutic eruption in his face, for which he has used a variety of remedies with no very beneficial effect, has lately applied the fumes of chalk and oil of vitriol to the parts affected. The operation occasions great itching and pricking in the skin, and some degree of drowsiness; but evidently abates the serous discharge, and diminishes the eruption. This patient has several symptoms which indicate a genuine scorbutic DIATHESIS; and it is probable that fixed air, taken internally, would be an useful medicine, in this case.

THE saline draughts of Riverius are supposed to owe their antiemetic effects to the air, which is separated from the salt of wormwood, during the act of effervescence. And the tonic powers of many mineral waters seem to depend on this principle. I was lately desired to visit a lady, who had most severe convulsive RETCHINGS. Various remedies had been administered without effect, before I saw her. She earnestly desired a draught of malt liquor; and was indulged with half a pint of Burton beer, in brisk effervescence. The vomitings ceased immediately, and returned no more. Fermenting liquors, it is well known, abound with fixed air. To this, and to the cor-
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dial quality of the beer, the favourable effect which it produced, may justly be ascribed. But I shall exceed my design by enlarging further on this subject. What has been advanced, it is hoped, will suffice to excite the attention of physicians to a remedy, which is capable of being applied to so many important medicinal purposes.

P. S. 1776. May not mephitic water prove an active and useful remedy in such species of dropsies as originate from obstructions in the liver, or from a general *atonia* of the solids, and poverty of the fluids? From its stimulant and penetrating powers, it should seem well adapted to pervade the minutest series of vessels; as a strengthener, it will give vigour to the organs of digestion; and as a diuretic, will tend to carry off, by urine, the superabundant serosities. In the *anasarca* and *ascites* the blood is generally of a loose texture, and the coagulable lymph is sometimes so much dissolved, that the whole mass assumes the appearance of gelly. As fixed air has been shewn, by Dr. Hales and Dr. Macbride, to be a bond of union to the particles of matter, may not mephitic water contribute to
supply

supply the animal fluids with this cementing principle? Other tonic and diuretic remedies may be combined with this grateful liquor; and if the patient's thirst be immoderate, and his case attended with imminent danger, he may be allowed to drink of it to satiety(*b*). The waters of Bath in Somersetshire, have been found to be signally serviceable in œdematous swellings of the legs, which have succeeded intermittents; and also in anasarcas, when the strength has not been too far impaired(*i*). I have repeatedly experienced the salutary effects of Buxton water

(*b*) *Sanatur, indulgens sibi, dirus hydrops.*

THE following passage is extracted from a letter which I have lately received from my learned friend Dr. Baker.

“ HAVE you heard of M. Bacher? Such is said to have been his success in dropies, that the French government has been induced, from the report made of the effects of his *tonic pills*, to purchase the secret of their composition; trials being first made under the eye of the court physicians. The chief ingredient in the pills is the black hellebore; but Bacher says, that without the assistance of *diluents* he could do nothing. ‘*Le malade buvoit a sa soif,*’ is the language of every page. This puts me in mind of some cases, which I published, in the second volume of the Medical Transactions; and I have lately been informed from Vienna, that Dr. Colin has more success than others with the same medicines, probably because his patients are allowed to drink *ad libitum*.”

(*i*) See Falconer on the Bath waters.

in

in similar cases: And as these celebrated springs owe their virtues, in part, to the mineral spirit which they contain, their efficacy in dropfies affords sufficient encouragement to the trial of mephitic water, in the same disorders.

FIXED AIR, conveyed by a proper tube into the nostrils, seems likely to prove the best topical application in the OZÆNA; whether the disease be seated in the *antrum Highmorianum*, or in the frontal sinuses. It will be easy to guard the patient against drawing into his lungs too large a quantity of this air, by directing him to breathe with his mouth open, during the operation.

E S S A Y V.

O N T H E

ANTISEPTIC AND SWEETENING POWERS;

AND ON THE VARIETIES OF

F A C T I T I O U S A I R.

THOUGH the fact has lately been controverted by an ingenious writer, I am fully convinced with Dr. Macbride, from the evidence of repeated experiments, that fixed air has the property both of retarding and of correcting putrefaction. It may afford matter of amusement, to consider in what manner these effects are produced.

THAT fixed air may restrain, and even prevent putrefaction, without possessing any inherent antiseptic quality, is not difficult to conceive. For by surrounding the putrescent substance with that kind of air, which it yields by putrefaction, and which requires some vehicle to discharge or carry it off, the separation of it is prevented, and the body thus retained in its original state. This

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may

may be illustrated by a wet sponge or cloth, which will never become dry in an atmosphere saturated with moisture : Or still more appositely by putting a mixture of sulphur and iron filings in a confined place, or into air in which candles have burned out. Under these circumstances, no heat, effervescence, or fume can be generated ; whereas the same mixture in fresh air presently grows hot, smokes copiously, and smells very offensively (*a*). The same observation will account for the curious fact, mentioned by Dr. Alexander, that the *effluvia* of putrid substances retard putrefaction in the bodies exposed to them. Perhaps, however, the generation of a volatile alkali may have some share in producing this effect.

BUT supposing the foregoing hypothesis to be well founded, which I advance only as conjecture, how are we to explain the sweetening powers of fixed air ? An eminent philosopher seems to hint that fixed air may act as a *menstruum* for the putrid *effluviu*m, and thus imbibe or discharge it from the septic body. The same idea suggested itself to Mr. Henry, in consequence of the following experiment, to which I was a witness. A piece of putrid flesh was suspended twelve hours, in a three pint bottle closely corked, and filled

(*a*) SEE Dr. Priestley's most ingenious papers on factitious air, which will probably be published in the LXII. vol. of the Philos. Transf.

with fixed air, which had been separated from chalk by the vitriolic acid. The beef was considerably sweetened, but the air in the bottle was rendered intolerably offensive. Now it affords a natural solution of this fact, if we admit that fixed air, by the laws of chemical affinity, abstracts from the septic body, and holds suspended or dissolved the putrid particles which it emits. And such an affinity seems probable, from their ready combination, as well as from their disposition to fly off together from putrefying substances. But how is the putrefactive process checked, and the fresh generation of *effluvia* restrained, under such circumstances? A piece of the same flesh, which was employed in the foregoing experiment, was left all night in the external air, by the circulation of which the *effluvia* could not fail to be carried off, as they were formed; yet the offensive odour of the flesh was not diminished. Has not the reason of this difference, between the exposure of a putrid substance to common air, and to mephitic air, been before assigned, when it was suggested that the latter may perhaps restrain the flight of that principle in bodies, the separation of which constitutes an essential part of the process of putrefaction? Animal flesh will neither become putrid in *vacuo*, nor when closely confined from the access of common air. In both cases a vehicle is wanting for the escape

of the mephitic air. In like manner red hot wood ceases to burn in inflammable air, because such air is already saturated with phlogiston.

I HAVE advanced the preceding conjectures, concerning the manner in which fixed air may retard and correct putrefaction, not as affording me full conviction, or to indulge the spirit of hypothesis, but to promote the further investigation of a subject so curious and interesting.

EXPERIMENT I. It is a fact lately ascertained by a very accurate philosopher, that putrefaction generates air similar to that which animals have breathed. But this and the succeeding experiment shew that there is some little diversity in their properties and effects. Air was blown forcibly from the lungs, for a sufficient length of time, into a phial containing distilled water and iron filings. The water was then filtered, and a few drops of the infusion of galls were added to it. A dark red colour, inclining to purple, was instantly produced.

EXPERIMENT II (*b*). Eight ounces of ox-gall were poured into a bottle, which had a tube communicating with another phial, containing half an ounce of iron filings, and four ounces of distilled water. After standing two days, part of the water was filtered, and suffered no change of

(*b*) Communicated by Dr. Falconer of Bath.

colour

colour from the addition of an astringent tincture. But the next day, when the fermentation in the gall was more evident, another filtered portion of the water struck, with the same tincture, a deep rosy red. On the fifth and sixth days, when the gall became intolerably putrid, though the vapour still corroded the iron filings, it seemed to have lost the power of dissolving them. For the astringent tincture no longer produced any change of colour in the water, and the iron was evidently precipitated.

EXPERIMENT III (*c*). Solutions of iron in water, obtained by different kinds of fixed air, vary in the colours which they strike with an infusion of galls. When the vitriolic acid and fossil alkali are employed, a black tinge is produced; when magnesia, or calcareous earths and the same acid are used, a purple hue is struck; and when the air is supplied by fermentation, the artificial chalybeate is changed, by galls, into a rosy red.

EXPERIMENT IV. Air, discharged from chalk by the vitriolic acid, readily and perfectly combines with water; but when separated by the nitrous acid, the union is more difficult to be effected, and much less complete. And the artificial mineral water, made by the latter, is

(*c*) By the same.

more pungent and sparkling than by the former acid.

EXPERIMENT V. Factitious air, separated from steel filings by the vitriolic acid, neither occasioned any precipitation in lime water, nor rendered the caustic fixed alkali mild. Whereas the air, set free from chalk and magnesia by the same acid, instantly produced a milkiness in lime water, and restored to the caustic alkali the power of effervescence.

EXPERIMENT VI. A piece of putrid mutton, which had been employed as a standard in some other experiments, was divided into two equal parts: One of these was suspended by a thread in a phial, containing an effervescing mixture of chalk and dilute spirit of vitriol; the other in a similar phial, with a mixture of iron filings and the same acid. The mouths of the phials were slightly stopped with folded paper; and a brisk fermentation took place in each of them. After being exposed sixteen hours to the air detached from these substances, the bits of mutton were taken out, and examined. They were both considerably firmer in their texture; and the one, which had been suspended over the effervescing mixture of chalk and oil of vitriol, was entirely sweetened; but the putrid feter of the other was not in the least degree corrected.

EXPERIMENT VII. A piece of putrid flesh was suspended about half an hour, over a mixture of iron filings and nitrous acid, and was perfectly sweetened. It had acquired a pungent and slightly acid smell, but remained firm and free from fetor, when this odour was washed off. The water, in which the flesh was washed, did not effervesce with *lixivium tartari*; nor did the vapour, arising from the spirit of nitre and iron filings, produce any change of colour in a paper covered with syrup of violets; presumptive proofs that the sweetness of the flesh was not restored by any acid fumes.

THE fixed air of metals seems, by some of these experiments, to be of a kind different from that which is contained in alkalis and calcareous earths. And consequently the action of these substances, as *fluxes*, cannot be explained on the principle of their restoring the air which had been lost by calcination. Indeed there are other proofs that the resuscitation of calces does not depend on this cause. I have been assured by an able chemist, that he has repeatedly restored *minium* to its metalline state, by the caustic alkali, assisted by a proper degree of heat; and that several of the metals may be revived by the force of fire alone. It is true that a mild calcareous earth, employed as a flux, is always rendered caustic by the operation. But this may be owing to the action of the

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fire,

fire, and not to the loss of its air by elective attraction. Perhaps the operation of alkalis and calcareous earths, as fluxes, may depend on their absorbing the matter, which seems to be added to metallic substances, by the process of calcination, and which furnishes such an amazing increase of weight (*d*). Inflammable bodies may produce the same effect, by volatilizing and carrying it off.

(*d*) ANTIMONY, when calcined, gains one eleventh part of its original weight; zinc one tenth; tin one sixth; and lead, when converted into minium, one fourth.

E S S A Y VI (a).

ON THE

N O X I O U S V A P O U R S

O F

C H A R C O A L.

THE accurate and ingenious Dr. Hales has proved, by a great variety of experiments, that air enters in a very considerable proportion into the composition of all bodies; that air, thus combined, is in a fixed state, and contributes to form the union and firm connection of the constituent parts of bodies; and that on their de-

(a) THIS essay was communicated in 1772, by the late learned and much respected Dr. Dobson; who then resided at Liverpool, but afterwards removed to Bath. The few philosophical errors it contains must be imputed to the imperfect knowledge of factitious air, which subsisted at the time when it was written. I again insert it, with peculiar pleasure, as a memorial of reciprocal esteem and friendship. January 1, 1788.

struction

struction or decomposition, this fixed air is again restored to its state of elasticity.

FIXED AIR, whether procured by fire, fermentation, or chemical resolution, has been supposed to be a body *sui generis*; and to possess properties, by which it is always distinctly characterized. It is more conformable however to the simplicity which is constantly observed in the operations of nature, to conclude, that as it is common atmospheric air which enters into the composition of bodies, it is likewise the same air which is again detached, on their decomposition or destruction; that its varieties depend on adventitious matter; and that it has different degrees of mixture and composition, accordingly as it is obtained from different substances, or by a different process.

THAT by degrees however; it is decomposed; returns to its original simplicity; is restored to the common magazine from which it was taken; and that the atmosphere is thus constantly gaining, by one process, what it loses by another.

FACTITIOUS or FIXED AIR is the general term, by which this subject is distinguished; and when it produces any noxious effects, either in consequence of the process by which it is procured, or the manner in which it is applied, it may then be properly called MEPHITIC AIR.

MUCH has been done, by some very ingenious modern writers, to illustrate this subject; and
much

much still remains to be done, to compleat the chemical and medical history of fixed air. -The present commentary chiefly respects the factitious air of charcoal; or the mephitic vapours which arise from this substance, in the state of ignition. And the following history points out both the noxious qualities of these vapours, and their mode of action on the animal œconomy.

OCTOBER 5, 1769. A servant to a gentleman's family in Liverpool, shut himself up in a small room to clean plate. In this room there was a chafing-dish of burning charcoal, and the door and window were closed. He soon felt himself *very ill*, as he expressed it; was chilly, sickish, and had shooting pains in the head. He continued to be affected in this manner for upwards of an hour and a half, during which time he had been twice called out, but returned again to the same situation in a few minutes. The chills, sickness, and pain in the head became more severe, and were increased by fits; he retched, but could not vomit. These were the only sensations he could recollect; and on my asking him, whether he did not feel an oppression at his breast, or a sense of suffocation, he answered in the negative.

HE remembered that he heard the clock strike eleven, which was an hour and a half from his first going into the room; and still finding himself

self very ill, but having no suspicion of the cause, he leaned forwards, rested his head upon his hands, and from that time had no further knowledge of what passed.

ABOUT half an hour after this, some of the family going near the door, were alarmed by his groans. The door was forced open, and he was found extended on the ground; his eyes fixed and staring; his hands clenched; his arms, legs, and whole body rigid; and his countenance, which was naturally pale, had now a death-like appearance.

HE was immediately carried into the open air; but it was with difficulty that his limbs were so bent that he could be seated in a chair. He continued to groan, and on the application of hartshorn drops to his nose, exerted a kind of motion, as if offended. Cold water thrown upon his face, had a more powerful effect to rouse him. After ten minutes, he came to himself; and in about twenty minutes, he was able to walk.

AT this time I first saw him. He complained of pain in his head, coldness and sickness; was hot to the touch; his pulse, small and frequent, 120 in a minute. While I was examining him, I observed his voice faltered; his eyes became fixed; he staggered forwards, and would have fallen, had he not been supported. He was placed in a chair, and remained in a state of insensibility

insensibility near a minute; there was no rigidity; the colour of the countenance did not change; but the pulse was extremely small, frequent, and irregular. On coming to himself, he complained much of pain in his head, was sick, retched, trembled, and was cold and hot by fits; a considerable degree of fever remained for two days, and then gradually left him.

WE have here a fair opportunity of observing the effects of these noxious vapours. The patient was near two hours struggling with the poison; and the whole progress of the symptoms clearly points out an immediate affection of the brain and nervous system, not of the lungs.

It is the common apprehension, that those who are killed by the effluvia of burning charcoal, are *suffocated*; and this apprehension is supported by the authorities of some very distinguished practical writers.

MORGAGNI, in his excellent work *de Sedibus et Causis Morborum*, asserts, that those who die from the *steams of charcoal*, the steams of the fermenting grape, in the Grotto di Cani, and in the cavern of Pyrmont, are *suffocated* (*b*).

HOFFMAN, in his Dissertation *de fumo carbonum noxio*, says, that these vapours being received into the breast, distend the lungs, prevent the ad-

(*b*) Epist. 19. § 40.

mission of air, and thus *suffocate* (*c*). The mode of operation is expressed in very strong terms. *Eadem enim horum operandi ratio est, ac si asperam arteriam filo constringas; nam utroque horum aeris sufficiens introitus impeditur* (*d*).

DOCTOR HALES concludes, that the steams of the Grotto di Cani, and several other noxious vapours, destroy the elasticity of the air, occasion the vesicles of the lungs to collapse, and thus *suffocate*, and cause sudden death (*e*).

SUCH are the respectable authorities which give weight to the common opinion, that those who are killed by these noxious effluvia, are suffocated. The following experiments, histories, and observations, tend however to establish a different doctrine.

WE learn from the experiments of the celebrated Greenwood, that the air of a well, in which the men who went down perished, and in which a lighted torch was instantly extinguished, did not differ from common air, either in gravity, humidity, or elasticity (*f*).

THE same is found to be true of the Grotto di Cani. In this, the height of the mercury in the barometer was not altered by the deadly

(*c*) Hoffman, tom. IV. p. 697. 22.

(*d*) Ib.

(*e*) Hales's Statics, p. 260, 261.

(*f*) Saggio delle Tranfar. tom. V. p. 2.

vapours (*g*). And we have the same proof of the state of the air in the cavern of Pymont (*b*). It appears likewise from the experiments of the learned Leonardo Capuano, that those animals which do *not breathe*, are destroyed in the Grotto di Cani, though slowly and with more difficulty (*i*).

DR. HALES indeed proves, that the fumes of burning sulphur, and the exhalations from the lungs of animals, bring into a fixed state part of the air through which they are dispersed, and consequently diminish its elasticity. That this circumstance however is not the cause of death, is hence evident; in high winds and storms, and on ascending very high mountains, a greater diminution of elasticity takes place, without such fatal effects (*k*).

ALL these noxious vapours, whether arising from burning charcoal, the fermenting grape, the Grotto di Cani, or the cavern of Pymont, operate nearly in the same manner. When accumulated and confined, their effects are often instantaneous; they immediately destroy the ac-

(*g*) Mead de Venenis, tent. 6.

(*b*) Commerc. litter. A. 1737. Heb. 8.

(*i*) Delle Mofette, Lez. 1.

(*k*) Veratti Com. Acad. Bonon. tom. II. part II. p. 271, 276. And Element. Physiolog. Haller. vol. III. p. 208.

tion of the brain and nerves, and in a moment arrest the vital motions. When more diffused, their effects are slower, but still evidently mark out a direct affection of the nervous system.

THOSE who are exposed to the vapours of the fermenting grape, are as instantly destroyed, as they would be by the strongest electrical shock. A state of insensibility is the immediate effect upon those animals, which are thrust into the Grotto di Cani, or the cavern of Pyrmont; the animal is deprived of motion, lies as if dead, and if not quickly returned into the fresh air, is irrecoverable. And if we attend to the histories of those who have suffered from the vapours of burning charcoal, we shall in like manner find that the brain and moving powers, are the parts primarily affected.

A cook, who had been accustomed to make use of lighted charcoal more than his business required, and to stand with his head over these fires, complained for a year of very acute pain in the head; and after this, was seized with a paralytic affection of the lower limbs, and a slow fever (1).

A PERSON was left reading in bed, with a pan of charcoal in a corner of the room. On being visited early the next morning, he was found with his eyes shut, his book open and laid on

(1) Morgagni. *Epist.* 64. § 15.

one side, his candle extinguished, and to appearance like one in a deep sleep. Stimulants and cupping glasses gave no relief; but he was soon recovered by the free access of fresh air (*m*).

Four prisoners, in order to make their escape, attempted to destroy the iron work of their windows, by the means of burning charcoal. As soon as they commenced their operations, the fumes of the charcoal being confined by the closeness of the prison, one of them was struck dead; another was found pale, speechless, and without motion; afterwards he spoke incoherently, was seized with a fever, and died. The other two were with great difficulty recovered (*n*).

Two boys went to warm themselves in a stove, heated with charcoal. In the morning they were found destitute of sense and motion, with countenances as composed as in a placid sleep. There were some remains of pulse, but they died in a short time (*o*).

A FISHERMAN deposited a large quantity of charcoal in a deep cellar. Some time afterwards, his son, a healthy strong man, went down into the cellar with a pan of burning charcoal and a light in his hand. He had scarcely descended to the bottom, when his candle went out. He

(*m*) Chesneau, 696.

(*n*) Donatus. Epist. 694.

(*o*) Id. 695.

returned, lighted his candle, and again descended. Soon after he called aloud for assistance. His mother, brother, and a servant hastened to give him relief, but none of them returned. Two others of the village shared the same fate. It was then determined to throw large quantities of water into the cellar; and after two or three days, they had access to the dead bodies. (*p*)

CÆLIUS AURELIANUS says, that those who are injured by the fumes of charcoal, become cataleptic. (*q*) And Hoffman himself, in another part of his works, enumerates a train of symptoms which, in no respect, correspond with his idea of suffocation. Those who suffer from the fumes of burning charcoal, says he, have severe pains in the head, great debility, faintness, stupor and lethargy. (*r*)

It appears, from the above histories and observations, that these vapours exert their noxious effects on the brain and nerves. Sometimes they occasion sudden death; at other times, the various symptoms of a debilitated nervous system, according as the poison is more or less concentrated. The olfactory nerves are first and principally affected, and the brain and nervous system

(*p*) Histoire de l' Academié de Science, Ann. 1710.

(*q*) De morbis acutis, lib. II. c. x.

(*r*) Tom. I. p. 229. § 5.

by sympathy or consent of parts. It is well known, that there is a strong and ready consent between the olfactory nerves and many other parts of the nervous system. The effluvia of flowers and perfumes, in delicate or irritable habits, produce a train of symptoms, which though transient, are analogous to those which are produced by the vapours of charcoal; viz. vertigo, sickness, faintness, and sometimes a total insensibility. The female malefactor, whom Dr. Mead inoculated by putting into the nostrils doffils of cotton impregnated with variolous matter, was immediately on the introduction, afflicted with a most excruciating head ach, and had a constant fever till after the eruption.

THE vapours of burning charcoal, and other poisonous effluvia, frequently produce their prejudicial, and even fatal effects, without being either offensive to the smell, or oppressive to the lungs. It is a matter of importance therefore, that the common opinion should be more agreeable to truth; for where suffocation is supposed to be the effect, there will be little apprehension of danger, so long as the breast keeps free from pain or oppression.

It may be well to remember, that the poison itself is distinct from that gross matter which is offensive to the smell; and that this is frequently in its most active state, when undistin-

guished by the sense. Were the following cautions generally attended to, they might in some instances be the happy means of preserving life. Never to be confined with burning charcoal in a small room, or where there is not a free draught of air by a chimney or some other way. Never to venture into any place in which air has been long pent up, or which from other circumstances ought to be suspected; unless such suspected place be either previously well ventilated, or put to the test of the lighted candle. For it is a singular and well known fact, that the life of flame, is in some circumstances, sooner affected and more expeditiously extinguished by noxious vapours, than animal life. A proof of which I remember to have received from a very intelligent clergyman, who was present at a musical entertainment at Oxford. The room was crowded; and during the entertainment, the candles were observed to burn dimly, and some of them went out. The audience complained only of faintness and languor; but had the animal effluvia been still further accumulated, or longer confined, they would have been extinguished as well as the candles.

THE most obvious, effectual, and expeditious means of relief to those who have unhappily suffered from this cause, are such as will dislodge and wash away the poison; restore the energy of the brain and nerves; and renew the vital motions.

Let

Let the patient, therefore, be immediately carried into the open air, and let the air be fanned backwards and forwards to assist its action; let cold water be thrown on the face, and let the face, mouth and nostrils be repeatedly washed; and as soon as practicable, get the patient to drink some cold water. But if the case be too far gone to be thus relieved, let a healthy person breathe into the mouth of the patient; and gently force air into the mouth, throat and nostrils. Frictions, cupping, bleeding, and blisters are likewise indicated. And if after the instant danger is removed a fever be excited, the method of cure must be adapted to the nature and prevailing symptoms of the fever.

E S S A Y VII.

O N T H E

A T R A B I L I S.

THE ancients, as appears from Galen, supposed the *atrabilis* to be derived either from the dregs of the blood, or from yellow bile torrefied and highly concocted. A celebrated modern anatomist is of opinion that it is blood, which having lodged some time in the intestinal canal, has acquired a blackness and putridity. But is it not more probable that, in general, it is no other than gall, become acrid by stagnation in the *vesica fellea*, and rendered viscid by the absorption of its fluid parts? When discharged into the *duodenum* in this state, it occasions universal disturbance and disorder, till evacuated either by vomiting or purging. I have lately had under my care a young Gentleman, labouring under a *marasmus*, produced by excessive intemperance. During the course of his disorder, which at last proved fatal,

fatal, he several times voided both by stool and vomiting, a considerable quantity of black, tenacious, and most offensive bile. The symptoms preceding the discharge, and which ceased soon afterwards, were a quick pulse, head-ach, delirium, hiccup, intense thirst, inward heat, and an uncommon fœtor in his breath. A lady aged thirty, unhappily addicted to habits which have a peculiarly pernicious effect upon the liver, after a constipation of the belly during six days, was seized with a violent and incessant vomiting of black and viscid bile. The *infusum senæ limoniatum*, warmed with the tincture of Columbo soon checked her retchings, and operating by stool, prevented the return of her vomiting. The matter discharged in both these cases bore not the least resemblance to grumous blood. I have several times observed the febrile symptoms in children, which are ascribed to dentition, relieved by these pitchy stools. And I recollect three cases of the *acute asthma*, as Dr. Millar names it, the paroxysms of which seemed to be critically terminated by a similar evacuation. Whether, in these instances, the black bile was the cause or the effect of the disease, cannot, with certainty, be determined; but the former appears to be the more probable opinion.

E S S A Y . VIII.

O N T H E

S E P T I C Q U A L I T Y

O F

S E A S A L T,

&c. &c.

SIR JOHN PRINGLE has shewn, that one drachm of sea salt preserves two drachms of fresh beef, in two ounces of water, above thirty hours uncorrupted, in a heat equal to that of the human body, that is, twenty hours longer than water alone; but that half a drachm of salt does not preserve it above two hours longer than pure water; that twenty-five grains have little or no antiseptic virtue; and that ten grains both heighten and hasten the corruption of the flesh (*a*). The result of this experiment is so curious and unexpected, that I wished to investigate the cause of it.

(*a*) Pringle's Diseases of the Army, Appendix, p. 38.

EXPERIMENT I. May 15, 1772. Equal parts, viz. two drachms, of the lean of mutton, chopped very small, were separately put into five wide mouthed phials, and to each were added two ounces of pump water. Ten grains of sea salt were dissolved in the first; the same quantity of brown bay salt in the second; of *sal catharticus amarus* in the third; and of true Glauber's salt in the fourth. The fifth contained only flesh and water, and was intended for a standard. The bottles were slightly corked, and after a gentle agitation placed in a window, exposed to the western sun. The mercury in Fahrenheit's thermometer then stood in the shade at 65 degrees.

IN twenty-nine hours the mixture which contained the *sal catharticus amarus* had acquired somewhat of a putrid taint.

IN forty hours the standard was slightly offensive. The mixture with sea salt was putrid, and that with the cathartic salt was yet more putrid.

IN fifty hours the standard and the two mixtures above-mentioned were equally putrid. The two others were sweet.

IN sixty-two hours the standard was become much more offensively putrid than the two mixtures with sea salt, and cathartic salt, in which the putrefactive process appeared not to have advanced any further. The flesh, with the brown
bay

bay falt, was now flightly tainted; but that with the true Glauber's falt was ftill fweet.

IN feventy-five hours the mixture with brown bay falt was become putrid, and that with the true Glauber's falt a little offensive. And in twelve hours longer the latter mixture was alfo putrid.

FROM this experiment it appears that common falt, in the quantity of ten grains, promotes putrefaction; and that the *fal catharticus amarus*, in the fame proportion, is yet more feptic; but that bay falt, in this quantity, refifts putrefaction; and that true glauber's falt exceeds, in this refpect, even bay falt. The feptic and antifeptic qualities of thefe falts, when ufed in fo fmall a quantity, are therefore evidently dependent on, and proportioned to their degrees of purity. Alimentary falt, it is well known, contains in its cryftals an earthy falt, fimilar to that of Epfom; which is a powerful ferment, almoft equally capable in a fmall as in a large quantity, of exciting the putrefactive procefs in fubftances difpofed to it. Whereas the pure neutral itfelf, which confifts of the muriatic acid and the foftil alkali, can only exert its antifeptic powers when ufed in a proportion adequate to the action of the bitter falt it is combined with, and fuperior to the putrid tendency

tendency of the animal flesh, it is employed to preserve (*b*).

EXPERIMENT II. May 21. Six days from the commencement of the experiment, the pieces of flesh in the solutions of common salt, and of *sal catharticus amarus*, were not more offensive than on the third day; and the mixtures emitted no air bubbles. But the standard, at this time, was intolerably putrid, very frothy, and the bits of mutton had risen to the surface of the water.

THIS experiment shews that both sea salt and the bitter purging salt, though they quicken putrefaction, prevent the progress of it beyond a certain degree. A quality which, must increase the usefulness of the former, as a seasoning to our food.

A LATE eminent and learned writer has related the history of a violent scurvy, produced by drinking sea water. A young lady, aged sixteen, tall, thin, and of a delicate constitution, though in tolerably good health, was advised to use sea water on account of a strumous swelling and inflammation of the upper lip. She drank a pint of it every morning, ten days successively; which

(*b*) SIR JOHN PRINGLE informs me, he has long suspected, but never ascertained the fact by experiment, that the septic quality of sea salt is owing to some heterogeneous substance joined to it.

did not pass off freely by the usual evacuations. At the end of this period, she was suddenly seized with a profuse discharge of the *catamenia*, was perpetually spitting blood from the gums, and had innumerable petechial spots on different parts of her body. Her pulse was quick, though full; her face pale and somewhat bloated; and her flesh soft and tender. She was often faint, but soon recovered her spirits. The flux from the *uterus* at length abated; but that from the gums increased to such a degree, that her apothecary took a little blood from her arm. From the orifice blood continually oozed for several days. At last an hæmorrhage from the nose came on, attended with frequent faintings, in which she at length expired, choaked as it were with her own blood. Before she died, her right arm was mortified from the elbow to the wrist. And it is further to be remarked, that though blood let from her, some weeks before she began the use of sea water, was sufficiently dense; yet that drawn in her last sickness was mere putrid, and dissolved gore (*c*).

DR. HUXHAM explains the dissolvent action of sea water, in this instance, by supposing an accumulation of the marine salt in the mass of blood, which running into *moleculæ*, too large

(*c*) Vide Philos. Transact. vol. LIII. p. 6.

to pass the minuteſt veſſels, occaſioned ſtagnations; and by irritating the capillaries, produced ruptures of them, extravafations, blotches, and livid ſpots. But do not the preceding experiments ſuggeſt a better ſolution of the fact? Sea water abounds with the cathartic ſalt, which conſtitutes the bitterneſs of it; and this has been proved to be a powerful ſeptic.

A PHYSICIAN, who often takes magnesia, to correct an acidity in his ſtomach, ariſing from indigeſtion, invariably obſerves that the diſcharges which it produces are peculiarly putrid and offenſive. Hence it is probable that this earth, combined with an acid of the vegetable, as well as of the mineral claſs, promotes putrefaction. Should we not, therefore, employ the *ſal catharticus amarus* and *magnesia alba* with caution, in diſeaſes of a putrid tendency?

I CANNOT omit this opportunity of recommending the calcination of magnesia, as a great improvement of that medicine. The loſs of its fixed air, which by this proceſs appears to conſtitute ſeven twelfths of its weight, obviates the flatulence which it produces in the *primæ viæ*, without diminiſhing its purgative or abſorbent qualities. Care, however, ſhould be taken that the magnesia be free from any calcareous earth, otherwiſe the action of the fire will render this mild powder offenſively cauſtic to the ſtomach,

as I have more than once experienced. Magnesia may be calcined with very little trouble; in a common crucible, placed in a glowing fire, and kept red hot during the space of two hours. This improvement was suggested to me by a physician in London, distinguished for his knowledge of chemistry.

E S S A Y IX.

O N

C O F F E E.

THOUGH Coffee has been in general use for more than a century past, has been analysed by fire, and variously investigated by writers of learning and reputation; yet neither chemistry nor experience have hitherto ascertained its true nature, or medicinal qualities. Of this the contradictory testimonies which have been delivered concerning it, afford a painful evidence. For it is surely to be lamented that an article of diet, active in its powers, and universally employed, should be so little understood. The following experiments may perhaps lead to farther inquiries on this useful subject.

EXPERIMENT I. Thirty berries of roasted, and the same number of unroasted Coffee were each digested, forty-eight hours, in two ounces of rectified spirit of wine. The former tincture was strongly impregnated with the peculiar taste and odour

odour of the Coffee; the latter had acquired little or no sensible flavour.

EXPERIMENT II. Ten drops of a solution of green vitriol, were added to a tea spoonful of each of the above-mentioned tinctures, diluted with an ounce of water. Both assumed a purple colour; but the change was greatest in the tincture prepared with unroasted Coffee. A similar difference was observable in the infusions of roasted and unroasted Coffee, prepared with water, allowance being made for the dark hue communicated to the *menstruum* by the roasted Coffee.

THESE facts evince the action of fire in diminishing astringency; and furnish an additional proof of the impropriety of employing heat in preparations of the bark, and other vegetables of a like quality.

EXPERIMENT III. Two drachms of roasted mutton, chopped very small, were digested in an ounce of pump water, and in the same quantity of a strong infusion of roasted Coffee. The phials which contained the mixtures, were placed at a moderate distance from the fire, so as to be kept nearly blood warm. In thirty hours the mutton and water became putrid; but the infusion of Coffee continued sweet twelve hours longer.

EXPERIMENT IV. To illustrate the action of Coffee on the digestion of food in the stomach, I prepared three alimentary mixtures, consisting of equal parts, viz. two drachms, of roasted mutton, of the crumb of bread, and of saliva, beat into a pulp, and severally combined with an ounce of the infusions of coffee, of green tea, and the same quantity of pump water. The bottles were placed, as in the former experiment, at a proper distance from the fire, and every now and then carefully examined. A fermentation was first perceived in the standard, i. e. the mixture with pump water, which became sour in about forty-eight hours. The infusion of Coffee emitted few air bubbles, and continued near four days without shewing any signs of acidity. By an accident, the phial, which contained the tea, was broken at the beginning of the experiment.

EXPERIMENT V. March 29, 1772. I awoke at five o'clock in the morning with the head-ach. My pulse was hard and full, and beat 92 strokes in a minute. I drank four dishes of strong Coffee. In half an hour the pain in my head was relieved; yet my pulse still continued to vibrate the same number of times, but was softer and less full. In an hour it sunk to 70. In an hour and a half it rose again to 76; and in two hours to 80, which is the standard of its frequency in health. I was in a recumbent posture

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during the whole time of this experiment, which I have since repeated several times, under different circumstances, with no material variation in the result.

FROM these observations we may infer, that Coffee is slightly astringent, and antiseptic; that it moderates alimentary fermentation; and that it is powerfully sedative. Its action on the nervous system probably depends on the oil it contains; which receives its flavour, and is rendered mildly empyreumatic by the process of roasting. Neumann obtained, by distillation, from one pound of Coffee, five ounces, five drachms and a half of water; six ounces and half a drachm of thick foetid oil, and four ounces and two drachms of a *caput mortuum*. And it is well known that rye, torrefied with a few almonds, which furnish the necessary proportion of oil, is now frequently employed as a substitute for these berries.

THE MEDICINAL QUALITIES of Coffee seem to be derived from the grateful sensation which it produces in the stomach; and from the sedative powers it exerts on the *vis vitæ*. Hence it assists digestion, and relieves the head-ach; and is taken in large quantities, with peculiar propriety, by the Turks and Arabians, because it counteracts the narcotic effects of opium, to the use of which those nations are much addicted.

IN delicate habits it often occasions watchfulness, tremors, and many of those complaints which are denominated nervous. It has even been suspected of producing palsies; and from my own observation I should apprehend, not entirely without foundation. Slare affirms that he became paralytic by the too liberal use of Coffee; and that his disorder was removed by abstinence from that liquor.

COFFEE berries are said to be remarkably disposed to imbibe exhalations from other bodies, and thereby to acquire an adventitious and disagreeable flavour. A bottle of rum, placed at some distance from a canister of Coffee, so impregnated the berries, in a short time, as to injure their flavour. Some years since a few bags of pepper were conveyed, in a Coffee-ship from India, the effluvia of which being absorbed by the Coffee, the whole cargo was spoiled (*a*).

P. S. 1776. A physician* was affected with a severe head-ach, October 19, 1774, in consequence of having been disturbed in the night. At two o'clock in the afternoon he took eighteen

(*a*) Miller's Gardener's Dictionary, eighth edit. Article, COFFEE.

* The author of these Observations.

drops of laudanum; and immediately afterwards, three dishes of very strong Coffee. He lay down, and endeavoured to compose himself to sleep. His pain abated in half an hour; and in an hour was entirely removed: but he felt not the least disposition to sleep, though he is often drowsy after dinner, and sometimes indulges himself in sleeping at that time.

November 1. HE repeated, on a similar occasion, the use of laudanum and Coffee, in the like quantity as before. The effects were precisely the same; ease from pain, but no disposition to sleep.

November 16. HE took eighteen drops of laudanum, when suffering under the head-ach, but without Coffee. The opiate composed him to sleep in an hour; but did not entirely remove the pain in his head. These facts confirm a remark which I have before made, that Coffee is taken, with peculiar propriety, by the Turks and Arabians, because it counteracts the narcotic effects of opium.

A VERY strong infusion of Coffee affords most relief, in pains of the head, when taken cold. And, in this form, it is an useful and agreeable vehicle to *Sp. Æther. Sp. Vol. Aromat. Elixir Paregor.* and other antispasmodic remedies. In the delirium of fevers, especially if the patient be comatose, Coffee is an excellent auxiliary to the usual

usual means employed. The odour of it is peculiarly grateful; and if inhaled a sufficient length of time, proves powerfully sedative. Mr. Pope is said to have derived great benefit from it, under the severe head-achs, to which he was liable; and I have seen many instances of its efficacy.

A DECOCTION of raw Coffee berries sweetened with honey, has been recommended in the gravel. I have no experience of the salutary effects of Coffee in this disorder; but I know that both roasted and raw it is an active diuretic; and I have frequently prescribed it with some success in dropsies, especially when originating from hepatic obstructions.

THE following curious and important observation is extracted from a letter, with which I was favoured by Sir John Pringle, in April 1773. "On reading your section concerning Coffee, "one quality occurred to me which I had observed of that liquor, confirming what you have "said of its sedative virtues. It is the best abater "of the paroxysms of the periodic asthma, that "I have seen. The Coffee ought to be of the "best Mocco, newly burnt, and made very "strong immediately after grinding it. I have "commonly ordered an ounce for one dish; which "is to be repeated fresh after the interval of a "quarter, or half an hour; and which I direct to

“ be taken without milk or sugar. The medi-
 “ cine in general is mentioned by Musgrave,
 “ in his *Treatise de Arthritide anomala*; but I
 “ first heard of it from a physician of this place,
 “ who having once practised at Lichfield, had
 “ been informed by the old people of that place,
 “ that Sir John Floyer, during the latter years of
 “ his life, kept free from, or at least lived easy
 “ under his asthma, from the use of very strong
 “ Coffee. This discovery, it seems, he made
 “ after the publication of his book upon that
 “ disease.” Since the receipt of this letter, I
 have frequently directed Coffee in the asthma
 with great success.

A REVIEW OF THE MOST IMPORTANT CONCLU-
 SIONS DEDUCED FROM THE PRECEDING EXPE-
 RIMENTS.

1. **C**OLUMBO-ROOT yields its virtues
 most perfectly to rectified spirit of wine;
 and to other *menstrua*, in the following order.
 1. to French brandy. 2. to Madeira wine.
 3. to white wine. 4. to distilled water. 5. to
 white wine vinegar. 6. to hard pump water.

2. THE

2. THE watery infusion of Columbo-root is more perishable than that of other bitters. In twenty-four hours a copious precipitation takes place in it; and in two days it becomes ropy, and even musty.

3. THE addition of orange peel renders the infusion of Columbo-root less ungrateful to the palate.

4. TWELVE ounces of Columbo-root yield eight ounces and two drachms of extract, which retains the entire flavour of the root, and is equal, if not superior in efficacy to the powder.

5. PERUVIAN BARK resists the putrefaction of animal flesh more powerfully than the Columbo-root; but as a preservative of the bile from putridity, this root exceeds the cortex.

6. PERUVIAN BARK, mixed with putrid gall, instantly produces a coagulation, and considerably increases the fœtor of it. Whereas the infusion of Columbo-root unites perfectly with it, and very powerfully corrects its offensive smell. This serves, in some measure, to explain the action of this remedy in the *cholera morbus*, and other diseases attended with a redundancy and depravation of the bile.

7. COLUMBO-ROOT moderates, without suspending the fermentation of alimentary mixtures; prevents them from growing sour; and neutralizes

lizes acidities when formed, much more completely than Peruvian bark, or chamomile flowers.

8. COLUMBO-ROOT does not increase the quickness of the pulse; and may therefore be used with propriety in the *phthisis pulmonalis*, and in hectic cases, to correct acrimony, and to strengthen the organs of digestion.

9. THE Columbo-root is an useful remedy in the *cholera morbus*; in diarrhœas; in the dysentery; in bilious fevers; in a languid state of the stomach, attended with want of appetite, nausea, and indigestion; and in habitual vomitings, when they proceed from a weakness or irritability of the stomach, from an irregular gout, from acidities, or from acrimonious bile.

10. THE ORCHIS-ROOT might be cultivated to great advantage in England, and SALEP, which is a preparation of it, might be afforded at eight-pence or ten-pence *per* pound. Whereas foreign salep is now sold at five or six shillings *per* pound.

11. RICE, as an aliment, is inferior to Salep, being slow of fermentation, and a very weak corrector of putrefaction. It is therefore an improper diet for hospital patients; and more particularly for sailors, in long voyages; because it seems incapable of preventing, and will not contribute much to check the progress of that fatal disease, the sea scurvy.

12. CHEESE, when mellowed by age, ferments readily with flesh and water; but separates a rancid oil, which appears to be incapable of any further change, and must, as a septic, be pernicious in the scurvy. The same objection may be urged, with still greater propriety, against the use of cheese in hospitals; because convalescents are so liable to relapses, that the slightest error of diet may occasion them.

13. SALEP has the singular property of concealing the taste of salt water; a circumstance of the highest importance at sea, when there is a scarcity of fresh water.

14. SALEP retards the acetous fermentation of milk; and consequently would be a good lithing for milk pottage, especially in large towns, where the cattle, being fed upon sour draft, must yield ascendent milk.

15. SALEP, in a certain proportion, would be an useful and profitable addition to bread. For by absorbing and retaining more water than flour alone is capable of, it occasions a considerable increase of weight.

16. BUXTON WATER is found, by analysis, to contain calcareous earth, fossil alkali, and sea salt; but in very small proportions: For a gallon of the water, when evaporated, yields only twenty-four grains of sediment.

17. THE temperature of Buxton bath, is 82 degrees of Fahrenheit's thermometer ; that of St. Ann's well somewhat less.

18. BUXTON WATER, when drunk, quickens the pulse very considerably, and sometimes occasions the head-ach. By the mineral spirit which it contains, it readily dissolves iron ; and such an impregnation must, in many cases, improve its medicinal virtues.

19. MATLOCK WATER is grateful to the palate, and of an agreeable warmth, but exhibits no marks of any mineral spirit. It is very slightly impregnated with *selenites*, and contains a small portion of sea salt. Some have supposed that it is a chalybeate, but without foundation.

20. THE Bristol and Matlock waters appear to resemble each other, both in their chemical and medicinal qualities.

21. MATLOCK bath raises Fahrenheit's thermometer to the 68th ; the spring to the 66th degree.

22. FIXED AIR may, in no considerable quantity, be breathed without danger or uneasiness. And in several cases of the *phthisis pulmonalis*, the steams of an effervescent mixture of chalk and vinegar, have been inspired with great advantage. Antiseptic fumigations and vapours have been long employed and much extolled in such disorders. But their efficacy does not appear to depend

depend on the extrication of fixed air from their substance.

23. THERE appears to be a diversity in the properties, and effects of different species of factitious air.

24. THE fixed air of metals seems to be of a kind different from what is contained in alkalis and calcareous earth: And consequently the action of these substances as *fluxes*, cannot be explained on the principle of their restoring the air, which had been lost by calcination.

25. COMMON SALT, in the quantity of ten grains, promotes putrefaction; the *sal catharticus amarus*, in the same proportion, is yet more septic; but BAY SALT in this quantity resists putrefaction; and GLAUBER'S SALT exceeds, in this respect, even BAY SALT. The septic and antiseptic qualities of these salts, when used in so minute a quantity, is therefore evidently dependent on, and proportionate to their degrees of purity.

26. SEA SALT, and the bitter purging salt, though they quicken putrefaction, prevent the progress of it beyond a certain degree; a quality which must increase the usefulness of the former, as a seasoning to our food.

27. COFFEE is slightly astringent, and antiseptic; moderates alimentary fermentation; is diuretic;

diuretic ; and powerfully sedative. Its action on the nervous system probably depends on the oil it contains ; which receives a new flavour, and is rendered mildly empyreumatic by the process of roasting (*b*).

(*b*) *STUDIOUS*, literary men, and those confined by their occupations or professions to a sedentary course of life, are peculiarly incident to head-ach, indigestion, acidity, flatulence, a painful distension of the stomach. To such I recommend the daily use of a few grains of rhubarb, immediately before dinner ; and two or three dishes of very strong coffee, about an hour after it.

S E L E C T H I S T O R I E S
O F
D I S E A S E S,
W I T H R E M A R K S.

Longum iter per precepta ; breve et efficax per exempla.

SENECA.

(a) THE HISTORY AND CURE OF A DIFFICULTY IN
DEGLUTITION, OF LONG CONTINUANCE, ARISING
FROM A SPASMODIC AFFECTION OF THE OE-
SOPHAGUS. .

MISS L—r, aged thirteen, a sprightly girl,
of a delicate and irritable habit of body,
during several years had a difficulty of swallowing ;
which occasionally left her for a month or two,
and then suddenly returned without any apparent
cause. September 3, 1768, I was desired to
visit her. She had then laboured under her
disorder six or eight months without any inter-
mission, and was reduced almost to a skeleton,

(a) THIS Case was read before the College of Phy-
sicians, August 9, 1769, and is published in the Medi-
cal Transactions, vol. II.

though

though she still retained her natural vivacity. When she attempted to swallow solids, they passed down readily as far as the upper orifice of the stomach; but when arrived there, they were instantly, and with a strong convulsive motion, thrown up again. Liquids sipped slowly, and swallowed leisurely, met with no resistance; but if hastily drunk, or in too large a quantity, they were quickly regurgitated. Warm liquors were swallowed with more ease than cold ones; and in the evening, the difficulty in deglutition generally abated. She complained of no other pain but an uneasy craving in her stomach; nor was there any external swelling, or inward soreness, through the whole passage of the *œsophagus*. When she was in her ninth year the *catamenia* appeared, and had recurred once or twice since that time, without any regularity. Her belly was costive; her pulse was quick and small; and her feet were usually cold. She was neither of a sturmount nor scorbutic habit of body; and her friends could give me no satisfactory account of the origin or cause of her disorder.

I APPREHENDED her case to be spasmodic, complicated with a slight thickening of the *œsophagus* about the part affected, the consequence of a contraction so long continued. The following medicines were therefore prescribed.

R. *Elixir.*

R. *Elixir. myrrhæ comp. tinct. valerian. vol. aa.*
3iv. M. dentur guttæ viginti in thea pulegii
bis die.

R. *Ol. amygdal. 3j. sp. sal. ammon. cum calce*
viva 3vj. camphoræ oleo solutæ 3ij. ol. succin.
3iss. M. f. linimentum, quo bene fricetur spina
dorsi, a prima cervicis vertebra usque ad duo-
decimam dorsalem, mane & vesperi quotidie.

R. *Merc. dulcis sexies sublimat. gr. fs. mucilag.*
gum. Arab. 3ij. sp. nitri dulcis 3ij. vin. an-
timon. gutt. vj. Aq. fontan. 3ss. Sacchari alb.
3j. M. f. haust. hora decubitus quotidie su-
mendus, vini antimonialis dosin sensim augendo.

R. *Extract. cort. Peruvian. mollis. castor. Russic.*
galban. colat. aa. partes æquales, camphoræ sp.
vin. rect. trit. 3j. ol. succini. 3j. balsam. Pe-
ruvian. q. s. M. f. emplastrum scrobiculo cordis
applicandum, & semel in septimana renovandum.

DIRECTIONS were given that her feet and legs should be kept warm; that her drinks should not be taken cold; that her diet should consist of broth, mutton, or beef tea, as it is called, panada, vermicelli, sago, rice, milk, chocolate, cocoa, salep, &c. that a little wine should be occasionally allowed; that she should abstain from tea and coffee; that moderate exercise should be daily used; and that a nourishing clyster, prepared of milk, broth, &c. should be injected every morning and noon; to obviate the loosening effect
of

of which, a few red rose leaves were ordered to be boiled in it, or a little starch to be added to it.

SEPTEMBER 22. The liniment, calomel draught, and clyster, had been neglected. But the plaster had been applied; she had taken the drops with regularity, and had carefully observed the regimen prescribed to her. The difficulty in deglutition was sensibly abated, her appetite was mended, and she had recovered flesh and strength.

OCTOBER 1. The mercurial draught had purged her. To prevent this effect, fifteen or twenty drops of *elixir paregoricum* were added. But a few days afterwards it occasioned a soreness in her gums, and a slight salivation. The use of it was therefore discontinued.

OCTOBER 21. She could now swallow solid food without any difficulty. Her appetite was good, her belly regular, her pulse fuller and slower, her flesh and strength recruited, and her health, in every other respect, was perfectly re-established. I directed her to continue the use of her medicines, and to persevere in her regimen a month or two longer; and she has ever since been entirely free from her disorder.

I SHALL beg leave to make some general observations on obstructed deglutition, without confining myself to the particular consideration of the case which has been related.

I. A DIFFICULTY in swallowing may proceed from such a variety of causes, not easy to be distinguished, and yet each requiring a particular method of cure, that the physician's practice in such cases must be uncertain and perplexed. And what adds considerably to this embarrassment is, that the effect often co-operates with the original cause, and confirms the disease. Thus a constriction of the *œsophagus*, arising from a spasmodic affection, will, if it continue long, produce either an enlargement of the glands, or a thickening of the substance of the gullet, about the part affected. On the contrary, if the stricture proceed from a glandular tumour, from schirrosities, or fungous excrescences, it will at the same time be complicated with some degree of spasm; of which, amongst several instances that have fallen under my observation, I shall mention the following. A farmer's wife, aged fifty, of a strumous habit, perceived an impediment in her throat to the passage of solid food, some months before she applied for advice. Her disorder had increased by degrees, and she was then unable to swallow any thing but liquids. A surgeon examined the gullet with a probe, and found the two glands, which are situated about the fifth vertebra of the back, considerably enlarged. Ether was then a fashionable remedy in this part of the country; and she was induced, by the same of its effects,

to wish a trial might be made of it. A dose, properly diluted, was given her, and about half an hour afterwards she had the power of swallowing, without much difficulty, a morsel of solid food. But the relief was only temporary. She relapsed in an hour or two, and had again recourse to the same remedy, which after a few trials lost all its efficacy; and the poor woman having languished about six months, died literally famished. From this and other instances, I should apprehend that the use of antispasmodics would assist the operation of the mercurial course, so judiciously recommended by Dr. Munckley in the first volume of the Medical Transactions; and would quicken, as well as render more certain the cure of this deplorable disease.

II. IN spasmodic affections of the *œsophagus*, external applications to the spine are likely to be very serviceable, from the contiguity of that tube to the *vertebræ*. And, perhaps, nothing would be more effectual in such cases than a blister, applied either to the neck, or between the shoulders. That epispastics are powerful antispasmodics, experience hath fully ascertained; and when the disorder is attended with an enlargement of the substance, or a fullness of the glands of the gullet, they would have additional efficacy, by producing a copious discharge of serous humours,

and

and by that mean unloading the vessels of the part affected.

VOLATILE and antispasmodic liniments are also highly useful, as the case above recited sufficiently evinces. It is indeed to be lamented that external applications of this kind are not more frequently employed in practice ; for there is just reason to apprehend that powerful effects might be expected from them in various diseases. In the whooping cough particularly, I have observed considerable benefit to accrue from the use of a liniment, similar to the one prescribed above.

III. WHEN constrictions of the *œsophagus*, arising from spasm, have been of long continuance, and do not yield to medicine, electricity furnishes us with no improbable means of relief. The public indeed have been much disappointed in the medical effects of electricity. But this hath, in part, proceeded from the misapplication of so powerful a remedy. It appears to me, and I am confirmed in this opinion by the observation of a very eminent physician, that the electric shock bids fair to do much more good in diseases from rigidity, than in those from laxity. Amongst many other proofs of this, may be adduced the cure of an universal *tetanus*, the history of which is published by Dr. Watson, in one of the late volumes of the Philosophical Transactions.

IV. STIMULATING vapours conveyed into the *pharynx* have a tendency to remove spasms, even when seated deep in the *œsophagus*. A few years ago, an elderly gentlewoman, after eating pease, felt an uneasy sensation as if one of them stuck low down in her throat, and suddenly found herself deprived of the power of deglutition. Notwithstanding the use of a variety of remedies, her inability to swallow continued five or six days. She was directed to fumigate her throat with *assafœtida*, dissolved in a strong infusion of the aromatic herbs : and drawing in the vapours very forcibly, the spasm was instantly resolved ; nor has she ever since suffered the least return of it.

V. WHEN this dreadful disease is so confirmed as to be deemed incurable, the patient's life may be prolonged by the daily injection of nutritive clysters, and by bathing his feet, hands, and arms, and occasionally his whole body, in new milk, broth, decoctions of salep, fago, or vermicelli, &c. The absorption by the lymphatics of the skin is very considerable. It has been found by experiment that the hand, after being well chafed, will imbibe, in a quarter of an hour, nearly an ounce and a half of warm water. And allowing that the surface of the hand is to that of the body as one to sixty, the absorption of the whole, in the same space of time, would amount to upwards of seven pounds. The
copious

copious discharge of urine in the *diabetes*, so much exceeding in quantity the patient's drink, confirms in some measure this calculation. And the curious fact related by Dr. Chalmers, at the same time that it affords a further proof of the great absorption by the pores of the skin, points out to us the valuable purposes to which it may be applied, in the disorder under consideration. A negro man, who had eaten or drunk but little before he was gibbeted, in March, 1759, at Charles Town in South Carolina, and had nothing given him afterwards, regularly voided every morning a large quantity of urine, but discharged no more till about the same hour the next day. The dews of the evening, imbibed by the body, supplied in this case a superabundance of fluids in the night, and a sufficient quantity to support perspiration in the day. Had these fluids been of a nutritious quality, it is not improbable that, even under such circumstances, the poor negro might have been kept alive for a considerable length of time.

PROSPER ALPINUS relates that the Egyptian women, in order to become fat, use every day a tepid bath; and whilst they continue in it, receive nourishing clysters, and a variety of the richest foods. By these means the females of that country, particularly the Hebrew women who reside there, are for the most part immoderately

corpulent. *Illarum plurimæ perinde ac sues cernuntur pinguiſſimæ humi recumbentes, maximeque Hebrææ, quibus iſtud vitii aliis familiarius obſervatur.*

I HAVE not enlarged upon the neceſſity of conveying aliment into the body by clyſters, in obſtructions of the *œſophagus*, becauſe this muſt be obvious to every practitioner. The other method of nutrition, if not leſs known, is certainly leſs attended to, and in general is altogether neglected. It may perhaps be thought an omiſſion, that no notice has been taken of the adminiſtration of medicines under the form of clyſters, in theſe deplorable caſes. But I apprehend, however uſeful they might be in many reſpects, they would, in general, too much interfere with the nourishment of the patient.

C A S E S

O F

D R O P S I E S.

CASE I. **M**RS. P——N, aged 33, a woman of a very delicate constitution, and subject to a *profluvium mensium*, which had greatly impaired her strength, perceived, about two years ago, an indolent, moveable tumour in the lower part and left side of her belly, which gradually though slowly increased. Before it acquired any considerable bulk, her right leg began to swell, her urine was voided in small quantity; the symptoms of thirst and inward heat ensued; the *abdomen* became enlarged; a fluctuation was soon perceptible; and a complete *ascites* was formed.

THE tumour in the lower part of her belly, which from its situation I apprehend was an incysted dropfy of the left *ovarium*, now began to be extremely painful, the swelling of the *abdomen*

increased, a general *anasarca* was coming on, and her case became every day more and more deplorable. Such was the state of the disorder, when the patient, as she arose out of bed in the morning, (February 2, 1771,) was seized with a nausea, without any apparent cause, succeeded by a violent vomiting. At three o'clock in the afternoon I was first called to her assistance, and found her quite exhausted with incessant retchings. Her pulse was so feeble as to be scarcely perceptible, her extremities were cold, and her legs and thighs were affected with a most painful spasm. She had discharged near ten pints of water, and this evacuation had entirely removed the anasarous swellings, and greatly diminished the fullness and tension of the belly. The tumour of the left *ovarium*, though much decreased in bulk, was evident to the touch, and appeared to be still moveable under the fingers. Gentle cordials were directed to support the patient's strength; warm fomentations were applied to her legs and thighs; and an opiate was administered, to procure for her a short interval of rest and ease. She enjoyed a few hours refreshing sleep; the vomiting then recurred, and continued five or six days, with intermissions, which gradually became longer and longer. Her thirst, during these evacuations, was almost insupportable; but she refrained with great resolution from all liquids, except

except a little red Port wine, diluted with mint water. Oranges too were freely allowed, and were highly grateful to her. All her dropfical swellings were now removed; and the tumour of the *ovarium* itself was no longer perceptible. When the vomiting ceased, a gentle *diarrhœa* succeeded. An infusion of the bark, with the *sp. nitr. dulcis*, and *tinct. mart. in sp. salis* was given. Her thirst abated, her appetite returned, and in a few weeks she recovered a tolerable degree of health and strength; and still continues free from any of her former ailments, though it is now four months from the time when her vomitings commenced. The quantity of water she discharged, exclusive of her evacuations by stool and urine, amounted to about three gallons.

THE case, before us, affords a striking proof of the efforts which nature exerts to relieve herself. By what secret instruments this salutary change was produced in the present instance, we may conjecture, but cannot ascertain. It is not to be supposed that the extravasated fluids passed, by percolation, through the coats of the stomach or intestines, and were then discharged by vomiting; because these coats in the living body are impervious to water, and transmit it only when the circulation ceases, when their vessels shrink, and the *mucus*, lining the internal cavity, is dried or abraded. Nor is it easy to conceive, how the hydropic cyst of the

ovarium

ovarium should thus empty itself into the ventricle; or so large a quantity of water transude, with such rapidity, through the interstices of its fibres. For that the stomach was not ruptured is evident from the speedy recovery of the patient. The effect therefore must be ascribed, not to a mechanical cause, but to that vital energy which, by imperceptible means, regulates the motions, and corrects the disorders of the animal frame; though sometimes with a degree of violence dangerous to, and even destructive of life. In the present case, it appears probable, that a sudden change took place in the course of circulation; the lymphatics recovered their power of absorption, and performed their office with renewed vigour; the vascular system became overloaded, and the exhalant arteries of the stomach and intestines poured forth the superfluous fluids, restoring thus the equilibrium.

INSTANCES of a sudden, and partially increased action of the vessels frequently occur; as in the *diarrhœa*, *cholera morbus*, hysterical disease, *profluvium urinæ*, &c. &c. But the following history, related by Doctor Simson, admirably illustrates, and at the same time confirms, what I have advanced. *Cum homo adolescens, febri correptus, cui accesserat diarrhœa, cum extremo stupore sensuum, nihil plane ore haurire vellet (quamquam immoderato æstu totus torresceret) quo humectaretur,*
jubeo

jubeo in aquam egelidam immergi pedes ; quo factò, protinus aquæ mirum cerno in vase decrementum, deinde ejusdem vixdum coloratæ, e vestigio impetuosam, more cataractæ, per anum effusionem (a).

SEVERAL instances are recorded of anasarcas, and some few even of the ascites, which have been cured by vomiting. But I believe it has rarely if ever happened, at least I do not recollect such a case either in books or in practice, that a dropsy of the *ovarium* has been removed by the spontaneous efforts of nature. Deductions from singular and solitary facts, though contrary to the rules of philosophizing, are not always to be rejected ; but may be allowed, with proper caution and reserve, when the nature of the subject admits not of better evidence. The history before us furnishes, I apprehend, an exception to the general laws of reasoning by induction ; and one instance, well authenticated, of the cure of a disease, which the most eminent physicians have considered as irremediable, may justly lead us, in similar circumstances, to imitate by art the operations of nature ; and to excite those efforts, which when spontaneous, have proved so salutary. In the incipient state of a dropsy of the *ovarium*, emetics, repeatedly administered, would be likely means of promoting the absorption or discharge

of the incysted fluid. They produce the strongest contractions in the abdominal muscles, agitate all the viscera of the lower belly, quicken the circulation of the blood, and by their general action on the whole system, remove obstructions in the minutest and most remote series of vessels. Hence the powerful effects of Turpeth vomits, in white swellings of the joints; in which the glands are at least equally diseased, and the extravasated fluid as much out of the course of circulation, as in the species of dropfy we are now considering. But unfortunately this disorder is so insidious in its attack, and so little alarming in its progress, that it becomes almost incurable before the patient is apprehensive of any degree of danger. However, in its more advanced stages, emetics may be administered with safety, and sometimes perhaps with advantage. If the *morbus diaboli* adhere to the enlarged *ovarium*, and the fallopian tubes be not totally obstructed, the action of vomiting may force a passage for the fluid, and thus procure at least some temporary relief. I have now under my care a lady, who has long been afflicted with a dropfy of this kind, and who has frequent discharges of bloody water from the womb, succeeded always by a diminution of bulk. A troublesome *hernia* forbids the exhibition of an emetic, which otherwise I should not hesitate to direct. Besides we may possibly be so fortunate as to co-operate

operate with nature at the most favourable conjuncture; and by assisting her efforts, of themselves perhaps too languid, may effect a cure. Such instances do not unfrequently occur, in almost every species of disease; and it is upon this principle alone, that we can explain the amazing success which has attended the exhibition of remedies, by no means adequate to the effects produced by them. Mr. W. a hard drinker, when past the meridian of life, had a jaundice which was succeeded by an *ascites*, a dropsy of the *thorax*, and an *anasarca*. The prognostic was in this case extremely unfavourable, and I scarcely indulged the least hope of his recovery. Diuretics, purgatives, &c. under various forms, were assiduously administered, but with no very advantageous effects. Amongst other medicines, he had pills composed of *extract. jalap. pulv. scillar. siccat.* and *merc. dulcis*, and was directed to increase the dose of these *pro re nata*. Finding the usual quantity insufficient to procure the necessary discharges, he took, if I recollect aright, two pills extraordinary, the consequence of which was an *hypercatharsis*, which greatly reduced his strength, but carried off all his dropical swellings, and by the aid of cordials and corroborants, produced a perfect cure. The following curious case, communicated to me by a physician of eminence in a neighbouring town, further illustrates the observation

observation advanced above; and at the same time shews the resources which medicine affords to a sagacious practitioner, in the most desperate stages of this disorder.

CASE II. Miss H. of Namptwich in Cheshire, aged upwards of forty, had laboured for some time under an *ascites*, when she was removed to Liverpool in February 1769, for the benefit of medical advice. Two physicians and a surgeon were consulted; and after a gentle evacuation by stool, and the exhibition of a few cardiacs, it was agreed that she should be tapped without delay. Eighteen pints of water were drawn off, and two large schirrous tumours, one nearly the size of an infant's head, the other not much less in bulk, were discovered. These she had perceived for many years, and they had succeeded a fever, imperfect in its crisis. The operation had almost proved fatal to her; her mouth was covered with *aphthæ*, and so many alarming symptoms came on, that death was hourly expected. However in a fortnight she was tolerably recovered, and in a month the *paracentesis* was again repeated. She bore it better, but soon filled again; and was obliged to submit to the operation every third week. Tired with the frequency of this painful palliative, after the fifteenth repetition of it, she requested one of her physicians, in a most pressing manner, to prescribe some medicine, which

which might at least protract the period of tapping. It was now the latter end of August; the weather was favourable, and he directed her to be confined to her bed for three days; to be assiduously rubbed morning and evening with dry cloths, impregnated with the fumes of camphor; and to take internally the *julepum e camphora*, prepared with only two thirds of a pint of water, and warmed with the addition of one ounce of *aqua juniperi composita*. Under this form she took a drachm of camphor daily, for the space of a fortnight. A continued gentle *diaphoresis* was the happy consequence; every day she decreased in bulk; and the abatement of her swellings encouraged her resolutely to persevere in the use of her medicine. She recovered her health; and remained near two years free from any dropical complaints. But in the summer of 1771, her disorder recurred; and on the 16th of July she was again tapped. On the 8th of October following, she voided by the *anus* near twelve pints of a mucilaginous liquor, in colour resembling *pus*, but without any offensive smell. After this remarkable discharge, she was better for a short time; but a violent and very painful aphthous complaint, attended with a profuse spitting of viscid phlegm and saliva, ensued; by which her strength was exhausted, and she died on the 9th of November, quite emaciated.

ON the same day, her body was opened in the presence of two physicians, and other gentlemen of the faculty; and I am favoured by Mr. Wicksted, a very ingenious surgeon at Namptwich, who attended the patient during her last illness, with the following account of the appearances on dissection.

“ ON opening the abdomen, a large hard tumour presented itself, which on examination seemed to be the right *ovarium* very much enlarged, and schirrous. It was in figure like an impregnated *uterus*, filling the lower space of the abdomen, and rising several inches above the brim of the *pelvis*. This substance was found attached to the *uterus*, and weighed three pounds and seven ounces. By its pressure the *uterus* and bladder were forced down into the lower part of the *pelvis*; and when divided, it resembled a piece of boiled udder, in colour and firmness.

“ THE left *ovarium* was very hard, and enlarged to the size of a goose egg. The body of the *uterus*, which with the bladder had been pressed by the weight of the tumour out of its usual situation, was hardly to be distinguished from the left *ovarium*, which was nearly of the same size and firmly united with it, and seemed to be a little diseased. The fallopian tubes
“ were

“ were almost obliterated. The bladder and
“ ureters were found.

“ THE hydropic cyst (which extended to the
“ margin of the ribs, and appeared to be formed
“ either from the distended peritonæal coats of the
“ *ovaria*, or the duplicatures of the *peritonæum*)
“ contained three quarters of a pint of a fluid,
“ similar to that which had been evacuated by
“ stool.

“ THE stomach and intestines were in a sound
“ state, and no where adhered to the above-
“ mentioned cyst. But at the bottom of the
“ *pelvis* the cyst had a *firm attachment to the*
“ *rectum*, of the compass of half a crown; yet
“ there was no visible perforation, by which so
“ large a quantity of fluids could escape. The
“ *omentum* was wasted to a membranous ex-
“ pansion. The kidneys, spleen, pancreas, and
“ mesenteric glands were found. The substance
“ of the liver was not at all diseased, but its
“ whole convex surface was fixed, by strong
“ adhesions, to the *diaphragm*. Both lobes of the
“ lungs were found adhering to the *pleura*; their
“ internal structure, however, seemed to be per-
“ fect. The heart was in a good state; and
“ the *pericardium* contained about two ounces of
“ limpid water.”

CASE III. Mr. G. H. of Oldham, near Man-
chester, aged upwards of fifty, low of stature, cor-

pulent, and habitually addicted to intemperance, in April, 1770, was afflicted with a dry cough, *dyspnœa*, *ascites*, and swelled legs. By the use of pills composed of *sapo venet. gum. ammoniac.* and *pulv. scillar.* and a mercurial cathartic, which I directed to be repeated at such intervals as not to debilitate his strength, he recovered his former state of health. But on the second of January, 1771, I was again called to his assistance: He had been suddenly seized, a few days before, with a difficulty of breathing, which increased rapidly, and was then attended with a cough and frothy expectoration: His pulse was languid and oppressed, his heat natural, his face bloated, and his legs were slightly œdematous: The *abdomen* was not fuller than usual, nor had he, previous to his attack, any symptoms of water in the cavity of the chest. A brisk purgative, *radix Senekæ*, *oxymel scillit.* blisters to the legs, *camphor*, *sal. volatile*, venesection, &c. &c. were tried, but without effect. Respiration became more and more laborious; and in two days the patient was freed from his sufferings by death.

It appears probable that an *anasarca*, or infarction of the cellular membrane of the lungs, was the proximate cause of the *orthopnœa*, which in so short a time proved fatal to the patient. This disorder may, like other dropsies, arise from a general laxity of the solids, tenuity of the fluids,

fluids, or obstructed circulation of the blood; but in such instances the presumption is, that it will be slowly and gradually produced. How then are we to account for its sudden and rapid formation in the case I have just related? The ancient physicians, who had no opportunities of dissecting human bodies, observed in brutes, particularly in oxen, sheep, and swine, large hydatids in the lungs; and to the rupture of these, Hippocrates and Galen, reasoning from analogy, ascribed the *hydrops pectoris* in the human species. Willis and Morgagni have adopted their opinion, and confirmed the testimony of the father of physic, and his learned commentators. Morgagni says, *In sue autem, cæteroquin sano, ut cætera ejusmodi hic omittam, a me in bestiis, hominibusque conspecta, hydatidem vidisse memini, quæ minorem sui partem in pulmonis superficie ostendens, interius adeo se amplificabat, ut aquæ limpidæ uncias aliquot contineret (b)*. And another laborious anatomist (*Bonetus in Sepulch. Anatom. Obs. 33 and 36,*) informs us that the lungs of a man were found full of bladders which, when opened, discharged either water, or a clear liquor, resembling the white of an egg. These observations, I think, point out the cause, and at the same time account

(b) Morgagni de causis & sedibus Morb. epist. 16. Art. 36.

for the rapid progress, and fatal termination of the pulmonary *œdema*, under which my patient laboured. Some hydatids, contained in the cellular membrane of the lungs, were probably ruptured internally; and in a habit abounding with the *colluvies serosa*, the extravasated fluids would be every instant accumulating, and the bronchial vesicles becoming more and more compressed, suffocation inevitably ensued.

THE diagnostics of the *hydrops pectoris*, whether the water be contained in the cellular membrane of the lungs, or in the cavity of the chest, are sometimes very obscure. Doctor Hoadly relates that he was present at the dissection of a dropical man, from the symptoms of whose disease it was with such certainty concluded, that water was contained in one side of the breast, that the only motive for examination was to determine into which cavity the fluid was extravasated. On opening his body, however, they discovered not a single drop of water, but found an almost total adhesion of the external coat of the lungs to the pleura; together with an inflammation, and numberless small ulcers in one lobe.

A SENSIBLE fluctuation of water in the breast is a symptom which rarely occurs; and it appears from Morgagni's observations, that it is not unusual for patients, labouring under this disorder, to bear with ease a recumbent posture.

But

But an *œdema*, or dropfy of the cellular membrane of the lungs, when its attack is sudden, may often be distinguished by the following signs, though it must be acknowledged that they sometimes prove equivocal. The difficulty in respiration is constant, and increased by the least motion, yet not much varied by different attitudes of the body; the patient complains of great anxiety about the *præcordia*, and when he attempts to take a deep inspiration, he finds it impossible to dilate his chest, and his breath seems to be suddenly stopped. The pulse is small, languid, and oppressed; the face pale and bloated; the legs usually swelled; and the whole habit is, for the most part, leucophlegmatic.

A DISEASE so urgent in its symptoms, so quick in its progress, and so often fatal in its termination, requires a method of cure of adequate expedition and efficacy. A brisk mercurial cathartic, which will not only unload the intestinal canal, but promote absorption, by stimulating and increasing the action of the whole vascular system, should be administered without delay. I have lately seen surprizing relief, in a very alarming case, almost instantly procured by such a remedy (*c*). Blisters to the legs have, also, sometimes a good

(*c*) A similar case is recorded by Dr. Simson, in the *Edin. Med. Essays*, vol. VI. p. 126.

effect; for by destroying the cuticle, and *rete mucosum*, they discharge the water from the cellular membrane of a depending part, and thus in some degree produce a general depletion. Punctures, made with a small lancet, or with such an instrument as Dr. Fothergill has lately recommended, will answer the same end; and be less liable to produce pain and inflammation. Diuretics, sudorifics, and expectorants, as they increase the more fluid excretions, are indicated in this disease. And if the most powerful medicines of one class fail, recourse should immediately be had to another. Seneka root, in liberal doses, sometimes answers every intention, and operates powerfully by the skin, the kidneys, and the bronchial glands, to the great relief of the patient. But if the most active medicines prove ineffectual, and the aggravation of all the symptoms threaten almost instant dissolution, might not the *paracentesis* of the lungs be attempted, with safety and advantage? *Melius est anceps remedium quam nullum*, is an established maxim in physic, and certainly in this instance would justify the trial of an operation, which is neither very painful, nor likely to be attended with any dangerous consequences. Many cases have been recorded of wounds in the lungs, which have been healed, without much difficulty. Nor have such accidents been succeeded by an *emphysema*; for it may
be

be concluded from Mr. Hewson's ingenious experiments, that a puncture or incision will not occasion any emission of air, into the cavity of the *thorax*, on account of the effusion of blood, and subsequent inflammation, by which the divided vesicles are first filled, and afterwards entirely closed. To produce a discharge of air, a laceration or superficial abrasion of the lungs seems to be necessary; and hence it is that fractured ribs are the most frequent causes of the *emphysema*.

SHOULD the *paracentesis* of the lungs ever be deemed expedient, the chest may be perforated by cautiously dissecting with a knife, as in the operation for the *empyema*. If the lungs adhere to the *pleura* where the incision is made, they may be punctured with a lancet, and the water will thus be discharged without falling into the cavity of the *thorax*; but a trocar will be necessary to obviate, as much as possible, this inconvenience, if there be no adhesion. The operation, for evident reasons, should first be performed on the right side, and if this do not afford the patient sufficient relief, another opening may be made between the seventh and eighth ribs of the left side, in order to avoid the *pericardium*.

CASE OF A PALSY, ARISING FROM THE EFFLUVIA
OF LEAD, IN WHICH ELECTRICITY WAS SUCCESSFULLY EMPLOYED.

ELECTRICITY, like all other active remedies, may prove injurious as well as beneficial to the human body; and it is to be regretted that experience has not yet supplied us with any certain *criteria*, by which to determine when it will be hurtful, when innocent, or efficacious. That analogy may deceive us is evident from many examples. A girl, about sixteen, who had lost the use of her arm, which was greatly wasted, became universally paralytic, after being electrified; and remained so above a fortnight. The general palsy was removed by proper medicines; but the diseased arm continued as before. Electricity was again tried, and repeated three or four days, when the girl became a second time universally paralytic, and even lost the use of her tongue. By a course of medicine, she was once more relieved from this additional palsy; but the original one, which affected her arm, remained incurable (*a*). A gentleman, aged forty-eight, inclined to corpulency, and of a phlegmatic temperament, had a paralytic

(*a*) Vid. Philos. Transact. vol. XLVIII. p. 786; also Priestley's History of Electricity, p. 386.

affection of the leg and thigh. Electricity was tried, but the slightest shocks always increased the torpor of the limb. The same gentleman, twelve months afterwards, was attacked with an *hemiplegia*. To gratify his inclination, and contrary to my own judgment, I consented to the use of electricity, a second time: and this remedy, which had before proved injurious, was now at least innocent, and even thought to be beneficial to him.

THE electrical shock, incautiously communicated, may be productive of dangerous and even fatal consequences. Mr. R. aged fifty, subject to various nervous and hypochondriacal complaints, after suffering several slight paralytic affections, which yielded to medicine, was at length deprived of the use of one side. Electricity, and other active remedies were applied. Gentle shocks were repeatedly given by a skilful person; and the patient seemed to receive benefit from each operation. But by an unfortunate mistake in the position of the chain, the shock was one day conveyed through the epigastric region, and not along the paralytic arm, which rested upon it. A violent pain was instantly perceived in the stomach, which, in a few minutes, was succeeded by a profuse vomiting of blood. The hæmorrhage continued two or three days, and so exhausted the

the strength of the patient, as certainly to accelerate, and perhaps to occasion his death.

PALSIES frequently succeed the *colica pictonum*; whether owing to some nervous sympathy between the bowels and the limbs, or to the translation of any morbid acrimony, cannot easily be determined. In such cases, the waters of Bath, in Somersetshire, are highly beneficial; and electricity, it is probable, would be an useful auxiliary to them. When the circumstances of the patient render a journey to those celebrated springs impracticable or inconvenient, the latter remedy may be tried alone, with some prospect of success. Of this the following curious case, communicated to me by Dr. Withering, affords a presumptive proof.

JOSEPH ADAMS, aged 20, was admitted into the Stafford infirmary on the 16th of September, 1768. Some months ago he felt a numbness and coldness in the left leg and thigh, which gradually extended all over him, his head excepted, which is now the only part he can move. His limbs are often seized with involuntary twitchings, as in the *chorea S. Viti*. Pulse natural. Appetite good. Costive. This man was formerly used to work in lead mines, at which time he was often sensible of a sweet taste in his mouth; but for two years past has been employed in digging a navigable canal, and has been much exposed to

wet

wet and cold. An antimonial vomit, a mercurial purge, and an emulsion, with a large proportion of *ol. olivar.* were prescribed.

ON the 21st. He could move his right arm, and his legs a little, as he lay in bed. A number of small electrical shocks were passed through both arms, and ordered to be repeated daily.

23d. SWEATS after being electrified; is universally warmer; can stir his left arm.

24th. FEELS a tingling in his right arm. His fingers contract upon the chain, when the shock passes. The frequency of his pulse is not increased during the operation. Electrify all his limbs.

27th. CAN shut both his hands, and bring the right up to his mouth, when lying in bed; but not when raised up.

29th. FEELS the shocks more sensibly than he did at first. They always excite a strong tingling sensation. When raised upon his feet, can stand upright betwixt two assistants.

AT this time it was discovered that he had several venereal shankers, and an ulcer upon the *glans penis*. The electricity was discontinued, and a course of sublimate solution, and mercurial unction entered upon; by which means all the venereal symptoms were subdued.

November 30th. His paralytic complaints being just in the same state as on the 29th of September,

September, recourse was again had to the electrical machine; and two large spoonfuls of *ol. olivar.* were given twice a day, to prevent costiveness.

December 18th. SWEATS when electrified: has more motion in his body; feeds himself in bed, but cannot when up. The fingers sometimes drawn inwards, so as almost to touch the palms of his hands; his arms and legs always benumbed; except for a short time after the use of the machine.

28th. PALSY much the same; for the relief, gained at the time of electrifying, ceases in a short time after it is over. Continues very costive. The antimonial vomit was repeated; a drachm of *pilul. gummos.* ordered to be taken twice in a day, with three ounces of the decoction of Peruvian bark. Omit the electricity.

January 10, 1769. THESE medicines at first gave him stools, but they have not now that effect. The palsy in the same state. Complains of great pain in the right shoulder, and right side of the neck. A blister was applied to the neck, the pills were continued, and the bark decoction was changed for four ounces of paralytic infusion. An ounce of volatile liniment was ordered to be rubbed daily upon the spine; issues to be made in the thighs; and when the blister healed, a seton in his neck. He continued nearly in this method

method until the 12th of April, without any other advantage than being free from his pains. He was ordered into the warm bath, every other day, and to take as much of the fresh leaves of cuckow pint (*b*), twice every day, as his stomach would bear.

May 3d. THE cuckow pint creates an uncommon heat in his stomach, but produces no other sensible effect. Let blisters be applied to his legs, and afterwards to the lower part of the spine.

28th. THE palsy continuing in the same state, recourse was again had to electricity.

August 21st. Has improved, though very slowly, in strength and motion. The muscles of his back allow him to stoop, and raise himself again: the right arm nearly as strong as when in health; but for more than a week past, his palsy has continued the same, and he complains of griping pains in his belly, which is tense and very costive. The usual medicines not giving him stools, let him take a large spoonful of castor oil every morning. Continue the electricity.

September 6th. FREE from the pain in his belly; the castor oil purges him considerably. Has more use in his left arm, and sweats profusely after electrifying.

(*b*) *Arum Maculatum*, *Linnaei Species Plantarum*.

13th. STOOD himself to day.

November 10th. CAN raise himself from his chair, and stand without help.

22d. WALKS about, with the assistance of his chair.

December 17th. DURING this month was a good deal afflicted with the gravel, which gave way to the usual remedies.

27th. WALKS with one stick.

January 3, 1770. BEGINS to walk without a stick. From this time he continued mending until the 11th of May; when he was discharged perfectly cured.

THE first circumstance which strikes our attention, in the history of this disease, is the distance of time betwixt the patient's exposure to the deleterious *effluvia* of the lead mines, and the appearance of the palsy. That the palsy was occasioned by lead is most probable; as there seemed to be, through the whole of the cure, more or less of the *colica pictonum* existing. The effects of the castor oil in this disease are too evident to pass unnoticed; especially as I have heard some very ingenious and candid practitioners assert, that they have found no more purgative quality in that oil, than in an equal quantity of olive oil. The medicine they used must have been highly adulterated.

THAT

THAT electricity does not afford relief in paralytic complaints, after five days application, has been asserted by a very ingenious philosopher; and I am afraid it is an opinion which has been too generally received. Dr. De Haen, in his *Ratio Medendi*, produces instances to the contrary; but none more striking than the above case, wherein it appears that the palsy continued in the same state, whenever the shocks were omitted. Patients are frequently discouraged by the painful sensation which large shocks excite, from persevering in an electrical course; and it is not uncommon to find, that any given degree of shock will occasion more pain in a diseased, and even in a paralytic limb, than in a sound one: I cannot omit adding, that I have never met with a case which resisted the power of small and repeated shocks, that would yield to great and terrifying ones. Like other active and useful remedies, electricity may be given in too large a dose, and may then produce considerable mischief. Nor are there wanting several well authenticated facts, to support this opinion. The largest shock I have ever found useful, has been from an eight ounce phial, coated in the common manner; and even this, in many irritable habits, is considerably too strong. For there is an amazing difference in the sensibility of different constitutions to the electrical stimulus. Quick, lively people

people feel the most from it ; those the least, who are dull and slow of apprehension.

WHEN the gout leaves the extremities, and invades other parts of the body, sinapisms, blisters, and volatile epithems, are often applied to the wrists or to the feet, to recall the disorder to its usual and natural seat. The same remedies are also employed to solicit the gout to the extremities, when it has yet made only irregular attacks on the system. Might not slight, or even severe shocks of electricity, be highly serviceable on such occasions ? The stimulating applications, above mentioned, chiefly affect the skin ; whereas the electrical stroke instantly pervades the tendons, articulations, and other internal parts, supposed to be the seat of this disorder.

IN palsies, proceeding from the recession of the gout, we should be less liable to disappointment in our expectations from electricity, when thus partially applied, than by the general shocks ~~so~~ indiscriminately given.

C A S E S

O F

O B S T I N A T E C O L I C S,

CURED BY THE USE OF ALUM.

A DUTCH writer of considerable merit, but not generally known in England, has recommended the use of alum in the *Colica pictonum*, and in other obstinate and painful affections of the bowels; and has favoured the public with several well authenticated histories of its beneficial effects (*a*).

I HAVE

(*a*) *De Colica Pictonum Tentamen, & Appendix*, auctore, Joanne Graafhuis, M. D.

“ CURATIONIS methodus (colicæ scilicet Pictonum)
 “ quatuor indicationibus absolvitur. Expostulat 1. leni-
 “ men doloris, nulla habita ad causam specialem ratione.
 “ 2. Causæ proximæ vel ablationem vel extinctionem.
 “ 3. Partium affectarum in integram, quantum fieri
 “ possit, restitutionem. 4. Alvi interea temporis, diffi-
 “ cillime in plerisque constipatæ, toto curationis decursu
 “ exsolutionem. Prima indicatio anodyna expostit;
 “ secunda demulcentia; tertia roborantia. Sine his,
 “ levatio morbi duabus prioribus indicationibus impe-
 “ trata, raro iuta fidaque est, hisce solis aliquando cura-
 Vol. I. D d “ tio

I HAVE administered this remedy in about fifteen cases, with a degree of success which confirms his testimony, and induces me to propose it to the trial of other physicians. The dose, in which I have given it, has usually been from ten to twenty grains, mixed with an equal proportion of sugar. When there was reason to apprehend that it might be too rough and austere in its action, I have directed it to be combined with gum arabic or *sperma ceti*: And in cases of flatulence, when a warm opiate was indicated, half a scruple of the *philonium Londinense* made an useful addition to it. Fifteen grains of alum, given every fourth, fifth, or sixth hour, for the most part prove gently aperient; and when the symptoms are not very severe, the second or third dose seldom fails to mitigate the pain; and sometimes entirely removes it. This remedy, when

“tio integre absolvitur absque ullo aliorum extradiſtis
 “jam indicationibus præſidio. Siquidem haud raro
 “vidi morbum anodynus & demulcentibus, ſeorſum et
 “per ſe, vel combinatis, ſat magnâ copiâ & fatis diu
 “aſſumptis, vinci non potuiſſe: in quibus caſibus omni
 “ſpe ſanationis impetrandæ abjecta, roborantibus fortio-
 “ribus non calidis, ut inteſtinorum tonus relaxatus
 “emendaretur, adhibitis, invincibilem ut videbatur
 “hoſtem proſtigari feliciter. Quare hæc methodus a me
 “tentata, deinceps mihi maxime commendabilis fuit;
 “eoque felicior quo medicamentorum adſtriſtoria poten-
 “tia major, eorumque propinatio liberalior diutur-
 “niorque.” De Colica Pictonum, p. 48.

continued

continued for a sufficient length of time, seems to abate flatulence, to obviate spasm, to improve the appetite, and to strengthen the organs of digestion. On these tonic powers the virtues of alum must chiefly depend; though they may, in part, arise from its obtunding the morbid sensibility of the intestines, by an immediate action on their nerves. To these it is applied more quickly, forcibly, and through a larger extent than most other astringents, from its ready solubility, great stypticity, and unchangeable nature. But without discussing the mode of its operation, I shall briefly relate the two following histories, selected from several others, of its salutary effects.

CASE I. January 28th, 1772. Mr. G. aged thirty, a temperate and active man, had been subject more than twelve months, to a violent pain in the right *hypogastrium*, which often recurred periodically, and continued two or three days, leaving a yellowness of the countenance, and great foreness of the *abdomen*. His belly was moderately soluble, and his pulse regular in the short intervals of his fits. For as he lived at a distance from Manchester, I had no opportunity of seeing him in the paroxysms of his disorder. The diagnostics of this case were obscure; but from a suspicion that his pain might be in the course of the ureter, I directed the following medicines.

R. *Pulv. Uvæ Ursæ* ʒj. *Aluminis usti* ʒss. *M. f. pulvis in doses 24 æquales dividendus; quarum capiat unam ter die, ex unciis tribus decocti sequentis.*

R. *Rad. Petroselini. Passular. solis. exacinat. aa* ʒj. *Semin. & summit. Dauci sylv. Herb. parietar. aa* ʒss. *aq. fontanæ* ℥iij. *coque ad* ℥ij. *colaturæ, & adde sp. Nitri dulcis* ʒj. *aq. Junip. com.* ʒiij. *M.*

THESE remedies were continued three weeks, and, during the use of them, the patient suffered no return of his disorder. The medicines proved diuretic; but he discharged no gravel, nor did his urine at this time assume any remarkable appearance.

MR. G. now considered himself as cured, and therefore neglected the repetition of his powders. In less than a month his colic recurred with great violence; and, April 27, 1772, he again applied to me for advice. I prescribed fifteen grains of burnt alum, and the same quantity of sugar, to be taken twice every day, in any agreeable vehicle, during the space of seven or eight weeks. And by steadily persevering in this course, he has remained six months entirely free from his disorder.

CASE II. September 21, 1772, E. P. a house-painter, aged 28, had complained several days of a violent pain in the region of the navel, attended with a slight nausea, and frequent cramps in the extremities. Sixteen hours before I saw him,

him, he had taken two doses of castor oil, which had yet procured no stool, nor afforded any relief. He was now afflicted, during the short remissions of his colic, with very severe pains in his arms and shoulders. His countenance was yellow; his pulse beat about seventy-five strokes in a minute; and his feet were cold. I directed him to go into the warm bath in the evening; and to take the following bolus every sixth hour.

R. *Spermatis Ceti*, *Aluminis rup.* aa ʒj. *Syr. simplicis* q. s. *M. f. bolus.*

THE pain was much abated by the use of this medicine, before he tried the warm bath.

APRIL 27th. HE had taken seven doses of alum, and was entirely free from pain; but remained extremely costive. The bolus was therefore omitted; and a solution of the cathartic salt in barley-water was ordered to be given at proper intervals, till several stools were procured. The succeeding day he continued easy: But to prevent a relapse, I prescribed a scruple of alum, mixed with an equal quantity of sugar, to be swallowed twice every day, during the following week or fortnight. The patient soon recovered his health and strength, and I have reason to believe has remained ever since free from his disorder.

Since the preceding account of the virtues of alum, in obstinate colics, was written, I have had long and full experience of the efficacy of this remedy, in various painful affections of the bowels, of the chronic kind, and not attended with inflammatory symptoms.

C A S E S

IN WHICH THE

W A R M B A T H

WAS SUCCESSFULLY EMPLOYED.

THE use of WARM BATHING is of great antiquity. Hippocrates recommends it in the strongest terms. *Calidum, seu Therma cutim emollit, attenuat, dolores tollit, rigores, convulsiones, nervorum distensiones mitigat, capitis gravitatem solvit (a)*. Aristotle, Pliny, Galen, and Celsus have given their testimony in its favour. The Romans derived this practice from the Greeks, and regarded it both as an efficacious remedy, and as one of the highest enjoyments of luxury. But under the reign of Augustus Cæsar, who was cured of a lingering and dangerous malady, by the use of cold bathing, the warm bath fell, for a short time, into disrepute. This appears from Horace :

*Sane Myrteta relinqui,
Dictaque cessantem nervis elidere morbum
Sulfura contemni vicus gemit, invidus ægris*

(a) Hippoc. Aph. 22. sect. 5.

*Qui caput & stomachum supponere fontibus audent
Clusinis, Gabiosque petunt, & frigida rura.*

Hor. Lib. I. Ep. xv.

VAPOUR bathing, as I am well informed, is an universal practice amongst the native Indians of North America. When afflicted with the rheumatism, a disease to which, from their climate, mode of life, and rigid fibres, they are peculiarly incident, they shut themselves in a close place; and pouring water upon a large stone, heated to a sufficient degree, they expose themselves for a considerable time to the steams which arise from it. Covered with a profuse sweat, they then plunge into the cold bath; and afterwards receive the hot vapours as before, repeating, for the most part twice or thrice, these severe operations. A similar practice prevails in Russia and Siberia; and every person in those countries, from the sovereign, to the meanest peasant, uses twice in a day such artificial hot baths. The Abbé Chappé d'Auteroche, who travelled into Siberia in the year 1761, by order of the king of France, informs us that the heat of these baths is raised to 148, and occasionally even to 168 degrees of Fahrenheit's thermometer. In this intense heat the Russians sometimes remain two hours, pouring hot water frequently over their bodies; and then rush into the open air, dissolved in sweat, to roll themselves in the snow, during the

the most piercing frost, when the thermometer stands ten degrees below 0. Many chronic diseases are cured by this method of bathing; and the rheumatism is said to be almost unknown in Russia.

PROSPER ALPINUS relates that warm baths are used by the Egyptians, in all fevers, except those of the pestilential kind; and in a variety of other disorders. They are employed also by the females of that country, especially by the Hebrew women, to render them more corpulent. *Quod ut obtineant, multis diebus, dulcibus tepidis Balneis indulgent, in iisque diu morantes, comedunt, potant, clysteribusque ibi ex variis pinguedinibus, ac adipibus paratis utuntur, multaque etiam medicamenta per os assument.*

IN England, warm bathing is rarely employed in private practice, notwithstanding several modern writers of reputation have strongly recommended it, and the experience of ages hath evinced its utility. To excite more attention to a remedy, which though well known is too much neglected, I shall briefly relate a few cases, in which it proved eminently successful.

CASE I. January 14, 1770. A young gentleman of an irritable habit, after drinking freely, and swallowing a large quantity of Cayenne pepper, was seized with an inflammatory *angina*. The fever, swelling of the *fauces*, laborious respiration,

spiration, difficult deglutition, and a violent pain in the head, were succeeded by a delirium; and although these symptoms were in some degree mitigated by venæsection, cathartics, blisters, leeches applied to the throat, *pediluvia*, and by nitrous and antimonial medicines, yet they continued with great severity; and the patient passed six days and nights, without enjoying the least slumber. Under these circumstances, (January 20th) the warm bath was prescribed, and the young gentleman directed to sit in it half an hour. The delirium soon abated; he fell into a profound and refreshing sleep, in which he continued thirteen hours; and then awoke entirely free from fever or delirium. And in a short time he recovered his usual health and strength.

CASE II. Master S. P. aged two years, healthy but of a delicate make, and with a head larger than is natural, was seized August 13, 1771, at one o'clock in the morning, with severe convulsions. He had been slightly indisposed a day or two before, and the preceding evening a few eruptions were observed on his face and neck. His sister had just recovered from the small pox, and he had not been separated from her during her illness; so that there remained no doubt concerning the cause of these symptoms. An emetic was administered, and a laxative clyster afterwards injected. But the fits continued with

with great violence, recurring at shorter and shorter intervals, notwithstanding the application of a blister to the back, an antispasmodic liniment to the spine, and the assiduous use of paregoric elixir, foetid *sal volatile*, musk, camphor, the *pediluvium*, &c. The child's strength was now almost exhausted, his respiration became laborious, his extremities cold, his pulse trembling, quick and languid, and his face was alternately flushed, and of a cadaverous paleness. The variolous eruption neither increased nor receded.

SUCH was the situation of my little patient at eleven o'clock at night, when I directed him to be immersed, as high as the chin, in warm water. The relief this afforded was almost instantaneous. Every convulsive motion ceased; his breathing became free and regular; he took notice of those around him; and seemed sensible of the present ease enjoyed. He remained in the bath about ten minutes, and was much refreshed by it, but had a fit not long afterwards: This however was very slight, and yielded immediately to a clyster prepared of a strong infusion of Valerian root and assafoetida, with a few drops of *tinct. Thebaica*, which was in readiness; and should have been injected on his coming out of the water. He retained the clyster only a few minutes; but passed the rest of the night in a composed and comfortable sleep, and the next morning the eruption

eruption was universal. The pustules were distinct; but so slow in suppurating, that they died away without coming to any degree of maturity, although a cordial diet was enjoined, the bark prescribed, and small doses of sulphur, mixed with syrup of poppies, were frequently administered.

CASE III. Mrs. H. aged thirty-five, a lady of a tender constitution, subject to scorbutic eruptions, and enfeebled by frequent child bearing, received, in the beginning of January 1770, a severe shock by the untimely death of an infant at the breast, which occasioned a miscarriage, and profuse uterine hæmorrhage. A variety of hysterical symptoms succeeded, and gradually increased. February 18th, my assistance was desired. She was then afflicted with great languor of body, and dejection of mind, with flatulence, want of appetite, and a violent sense of suffocation in her throat. Every morning a *delirium* came on, attended with severe convulsions. Her pulse was quick, fluttering, and irregular; her skin was dry, and since her miscarriage, free from any eruption; and she complained of an oppression about the *præcordia*. A blister to the head was directed; a cordial and nourishing diet recommended; and the frequent use of the *pediluvium* enjoined. The following medicines were also prescribed.

R. *Affasætidæ*

R. *Affafatidæ electæ* gr. xv. *Pulv. Ipecac. Extract. Thebaic.* aa gr. j. *Ol. Menthæ gutt.* ij. *Syr. simp.* q. s. *M. f. pilulæ mediocres, omni nocte hora somni sumendæ.*

R. *Pulv. Cort. Peruvian.* ʒj. *Rasur. Ligni Guaiac. Sassafrag. Cort. Winteran. Rad. Glycyrrhiz.* aa ʒij. *Aq. Font. ballient* ℥j. *Infunde vase clauso per sex horas, deinde cola.*

R. *Colaturæ præscriptæ* ʒiss. *Tinct. Valerian. vol. Tinct. Castor.* aa ʒj. *M. f. Haustus ter die sumendus.*

By these remedies she was much relieved, and continued better till the 12th of March; when she relapsed into all her former complaints, which recurred with an increased degree of dejection and anxiety of mind. Without my knowledge she had tried the cold bath, and had been sensibly injured by it. No eruption yet appeared on her skin; and the delirium, which was more violent than before, now invaded her always in the evening. Troches of sulphur, and the compound lime water, with the pills mentioned above, were at this time prescribed; and the patient was directed to use the warm bath every night, previous to the accession of the delirium.

March 13th. THE delirium recurred with much less violence, and was of shorter continu-

ance;

ance; and after bathing the patient fell into a sound and composed sleep.

March 16th. THE warm bath was omitted, and the delirium was much more violent, and lasted longer. The following draught was directed to be taken an hour before its accession, the succeeding evening, and the use of the bath to be repeated.

R. *Sagapeni*, *Mosch.* aa gr. x. *Camphoræ* gr. ij. *Mucilag.* *Gum. Arab.* q. s. *simul tritis gradatim adde Aquæ Menth. vulg. simp.* ʒiss. *Tinct. Valer. simp.* ʒij. *Syr. è Cort. Aurant.* ʒj. *M. f. Haustus.*

By these means, assiduously pursued, the patient recovered her health before the end of March. Whenever the warm bath was omitted, which happened twice or thrice, she suffered sensibly by the neglect. Her delirium was more severe, and of longer duration; her sleep was shorter and less refreshing; and the succeeding day she was more troubled with anxiety of mind, oppression about the *præcordia*, and other nervous symptoms.

CASE IV. A Clergyman, who resides about forty miles from Manchester, consulted me, by letter, in the beginning of March 1769. He had been several years afflicted with a variety of hypochondriacal complaints, which had succeeded the sudden repulsion of an eruption on his foot, by means of an astringent bath; and he was then
under

under a continual anxiety and distraction of mind. He had one prevailing idea constantly in his head, and one distressing image before his eyes. These symptoms of his disorder he ascribed to a violent commotion of mind, at a time when he was under great depression of spirits, and which occasioned a sudden start, or convulsive motion, in one part of his head. In this part he felt a constant and forcible spasm, which he supposed extended itself to his breast and bowels, as he generally perceived a sense of contraction in those parts, attended with an inward heat. His eyes were particularly affected, being drawn, as it were, out of their sockets, and endued with an unnatural sensibility. In a second letter, dated March 11th, he informed me that he perceived every night, when he lay in bed, a continual motion from his forehead upwards, and about his temples, like the undulation of waves. The uneasiness and pain in his head was so extreme, that he could not bear even the pressure of his hat. But all this bodily pain was trifling in degree, when compared to the distress of his mind, arising from the irresistible force with which external objects distracted his eyes and imagination.

UNDER these unhappy circumstances, he had consulted several physicians of great eminence, and had tried a variety of medicines, the detail of which, as well as of those which I prescribed to him,

him, would be equally tedious and unnecessary. Nothing had afforded him so much relief, as the warm *pediluvium*, and the extract of opium, of which he had habituated himself to take ten or twelve grains every day. Medicine proving so ineffectual, I advised the gradual discontinuance of his opiates; recommended the frequent use of the warm bath; and directed hot water to be poured in a stream, upon the part of his head which was most affected. The following passages, extracted from his letters, shew the beneficial consequences of this course. “ My days begin to be easier, and
“ I have not had such bad nights since I went
“ into the warm bath, which is near two months
“ ago. It has wonderfully softened and composed
“ my head, and enabled me to sleep sooner and
“ sounder than I used to do. I have made several attempts to use the cold bath along with it,
“ but I am always obliged to desist, as it immediately alters me for the worse, greatly increases
“ the distress in my head, and renders my sleep
“ more disturbed. I am however attempting it
“ again; and I hope with a better prospect of
“ success. I should be much encouraged by
“ finding myself able to bear it; as I am persuaded
“ it would have a happy effect in strengthening
“ and restoring me.” — “ I find myself daily advancing towards a more perfect state of health.
“ I have brought myself at length to bear the
“ cold

“ cold bath very well. I use it every other day,
“ and find a very happy effect from it, in restoring
“ my spirits, and strengthening my whole frame.
“ But it would not do without the assistance of the
“ warm bath, which is my constant antidote
“ against any disagreeable effects from the other,
“ and gives me never-failing relief and rest at
“ night. The pouring warm water, in a constant
“ stream, upon that part of my head, where my
“ complaint lies, has, I apprehend, been of singu-
“ lar service in softening and opening it, and
“ contributed greatly to that happy change which
“ I find in myself. I have been gradually wean-
“ ing myself from opium; and have reduced the
“ dose from three pills to one.”

THIS gentleman soon recovered his health, and has been ever since free from any returns of his disorder.

I HAVE recommended warm bathing in a variety of other complaints, and for the most part with the happiest success. Like other remedies, however, it has sometimes disappointed my expectations; and in two instances its operation proved in some degree unfavourable. The one case was a violent pain resembling the sciatica, but which I believe proceeded from an affection of the kidney. The other was a most troublesome sense of motion in the *uterus*, from one side of the pelvis to the other, which occurred at the end of

every fortnight, in the intervals between the *cata-*
menia, and lasted generally three or four days. The patient was free from this complaint when in a sitting posture; and it was most uneasy to her when she was walking. The warm bath aggravated the pain in the former instance; and seemed to protract the disorder a day or two in the latter.

MISCELLANEOUS

C A S E S

A N D

O B S E R V A T I O N S.

I. **I**T is highly probable that Palsies frequently arise from diseases of the *viscera*, without any previous fault in the brain or spinal marrow. And considerable errors may be committed in practice, by a want of precision in distinguishing the causes from which they proceed. Large evacuations are often indiscriminately directed in these disorders, from a supposition that they arise from plenitude; and thus irreparable mischief is done in those cases of weakness or irritability, which are now most numerous.

I HAVE seen several *hemiplegias* which derived their origin from affections of the liver; others from an *atonia* of the stomach and bowels; and three instances have occurred to me of palsies from pregnancy. The following history is of this kind.

MRS. D. of Rochdale, aged 21, whose *menfes* had always recurred with regularity, but attended with great pain and general diforder, in the fpring of 1771 had a mifcarriage. The following Auguft, the *catamenia* did not appear at the ufual period. She had a violent pain in the loins and about the *os facrum*, which continued feveral hours, and was then fucceeded by a pain equally acute in her head. Soon afterwards, ſhe loſt all power of ſpeech, and the uſe of her right ſide. Her habit was not plethoric ; but an experienced and ſenſible apothecary, before my arrival, had taken from her arm half a pound of blood ; had applied a bliſter to her back ; and a volatile liniment to the ſide affected. By theſe means ſhe recovered, in about ſixteen hours, the uſe of her ſide ; but ſtill complained of a *torpor* in it, and of a dull pain and confuſion in her head. Her pulſe was ſoft and natural ; and her blood of a proper texture. I conſidered the palfy as ariſing from an uterine affection ; and directed a gentle purgative of rhu-barb and magnesia, every other night, and an infuſion of Peruvian bark and Valerian, to ſtrengthen the habit of the patient, and to abate irritability. Venæſection was alſo recommended a few days before the next period of the *catamenia*. At the return of this period ſhe had a ſecond paralytic ſtroke, of the ſame kind as before, and preceded by the like ſymptoms. Venæſection had

had been omitted, and she had neglected her medicines. She was now evidently in a state of pregnancy. I advised a repetition of the remedies before prescribed; and recommended the use of a temperately cold bath. She complied with these injunctions, and had no return of her disorder.

II. FULLER, in his *Medicina Gymnastica*, strongly recommends COLTSFOOT, in consumptive disorders. It appears to be anodyne, and a corrector of acrimony; but only exerts these powers when taken in a large quantity. I gave a strong infusion of it to a young woman, who had various running sores, hectic heats, a colliquative *diarrhæa*, and wandering pains all over her body. It produced a better digestion in the ulcers; alleviated her pains; and abated the violence of the *diarrhæa*. Cicuta, and Peruvian bark were before administered with good effect; but had been for some time discontinued, on account of their expensiveness. I thought the *tussilago* afforded more relief to the patient than either of them.

III. LARGE doses of opium have been frequently administered, in painful and spasmodic diseases, not only with safety, but with the happiest success. Dr. Vaughan, of Leicester, informs me, that he lately gave to a lady, in the fifth month of her pregnancy, who had an acute pain in her bowels which threatened an abortion,

twenty-two grains of the extract of opium, and three hundred drops of laudanum, in the space of thirty-six hours. And by these means, and these alone, she perfectly recovered. But the nervous system, especially in spasmodic disorders, is subject to great and sudden changes, which must sometimes render the doses of medicines, powerful in their operation, uncertain and liable to produce the most dangerous effects. The following case, communicated to me by a young physician, who is likely to be an ornament to his profession, affords a striking confirmation of the truth of this observation.

A YOUTH, who was admitted into the hospital at — on account of a violent spasmodic disease, which recurred periodically in the evening, after trying a variety of remedies, was directed to take the *extractum Thebaicum*, in such a quantity as might prove sufficient to mitigate the violence of the paroxysms. The dose amounted to twenty-two grains, and was repeated every night, during the space of a week, without producing any soporific effects. On the eighth night it was observed that he had no return of the spasm; and in the morning he was found dead. It is probable that a sudden alteration had taken place in the nervous system of this patient, and that the opium, in consequence of it, exerted, with full force, its usual powers on the body.

IV. I have lately received, from a clergyman of great learning and humanity, a small quantity of feed, which is brought from the coast of Malabar, and is celebrated in the East Indies as a powerful remedy for the colic. It is called by the Portuguese AJAVA. “ Captain B. formerly
 “ commander of the Prince Henry Indiaman,
 “ procured some of it from the Jesuit’s College at
 “ Goa, brought it over with him to England, and
 “ distributed it amongst such of his neighbours and
 “ acquaintance as were troubled with the colic,
 “ who found great benefit from the use of it. Being
 “ himself exceedingly afflicted at times with the
 “ windy gout, and having in one of his fits applied
 “ several things in vain, he made trial of the *ajava*
 “ *feed*, and found it so very efficacious in expelling
 “ the wind, and removing the gout from the stomach
 “ and head, that he has ever since taken it
 “ on the like occasions. The most usual effect of
 “ it is to procure a plentiful discharge of wind,
 “ and sometimes it relieves the disorder by a stool
 “ or two.” From the sensible qualities of this feed, I should judge it to be an active remedy: But I have yet had no experience of its efficacy, and mention it only to promote an inquiry into its medicinal virtues.

V. A LADY, aged 40, was subject several years to an excessive degree of acidity in her stomach and bowels, which medicines sometimes palliated,

but never cured. By degrees the acidity abated, and at length entirely ceased; but she became subject to frequent diarrhœas, to a *profluvium mensium*, and to copious and sudden discharges of urine. She complained of great feebleness, of weariness in her legs, and of a constant pain in her loins. Her pulse was languid and slow, her skin cold, of a dark hue, and covered with freckles. She had often a putrid taste in her mouth, at which time the saliva was tinged with blood; and in the intervals of her *menfes*, she had a continual discharge of brown, foetid water from the *uterus*.

THESE symptoms are characteristics of a true scurvy or dissolution of the blood; which, in this instance, seems to have been produced by the long continuance of an acid acrimony in the first passages. Dr. Gaubius has well described the effects of such an acrimony. *Acor primis maxime viis infestus, tempore & sanguinem humoresque inde deductos subiens, nascitur ex usu diuturno acidorum aut acescentium, quæ viribus corporis non subiguntur; aut quia ex se indomabilia sunt naturæ humanæ, aut ob virtutis coëtricis impotentiam. Debilitas igitur solidorum universalis, aut privata viscerum primæ digestionis; irritabilitas regulares horum motus turbans; inertia defectusve succorum præparantium; circulationis & caloris naturalis languor; neglectus motus animalis, eo disponunt, ut pateat, cui maxime ætati,*

ætati, sexui, vitæ generi, hoc acre frequentius eveniat (a).

To determine the comparative nutritive powers of different foods, a few years ago, a physician, of distinguished abilities, made a variety of experiments, to which he at length fell an unfortunate sacrifice. I have been well informed that he lived a month upon bread and water only, by which he daily diminished in his weight. At the end of that time, he added sugar to his bread and water, and confined himself a fortnight longer to this diet. His breath then became offensive, his gums bled, putrid sloughs appeared in his mouth, and *vibices* spread themselves over different parts of his body. These symptoms were removed by a return to animal diet, and by the use of the bark.

It is contrary to the prevailing THEORY, that vegetable food should give rise to putrefaction in the animal system; but there are many proofs of the truth of it. Dr. Bisset relates several cases of highly putrid fevers, quick in their progress and fatal in their termination, wherein the septic ferment evidently began in the *primæ viæ*, after eating heartily of acescent food. Calves, also, put to graze in a rich pasture, towards the close of autumn, are sometimes affected with a putrid disease, which destroys them in thirty hours.

(a) Gaubij Pathologia, sect. 307.

The farmers call it the *quarter felon*, because one hind quarter becomes putrid and emphysematous; and as soon as the *emphysema* extends to the spine, the animal expires: It is most incident to calves that are healthy. Juices, which are perfectly animalized or assimilated, are less prone to putrefy than such as are crude, or blended with a great proportion of acedent chyle. The meat of bullocks and of sheep, which have been kept fasting a sufficient length of time before they are killed, that is till the recent chyle be completely assimilated, is firmer and continues sweet much longer, than the flesh of such as are slaughtered soon after taking them from their pastures (*b*).

THE learned writer, whom I have quoted above, observes: *Dulciaria, saccharata, mellita, hisque similia, usu immodico, per occultam acrimoniam dentibus inimica sunt; pro vi sua fermentante, acidum ingenerant, et quæ ex hoc profluunt mala; præterea solvunt tenuantque humores; horum minuta densitate et firmas partes relaxant; non uno hinc nomine generi nervoso infesta, infantibus, sexui sequiori, debilibus, hystericis, hypochondriacis, obfunt (c).*

FROM the useful and accurate experiments of Sir John Pringle, it appears that bread, water, and fresh gall, when fermented together, first

(*b*) Vid. Bisset's Medical Observations, p. 85.

(*c*) Gaubij Pathologia, sect. 470.

turned sour, then putrid. And Dr. Bryan Robinson found that perspiration is diminished by fruit, and garden vegetables. Perhaps these facts may reflect some light on the preceding observations.

VI. MR. WILLIAM WHITE of York, the ingenious author of an Essay on the Diseases of the Bile, has lately communicated to me some curious experiments on the solution of those calculous concretions, which are called gall stones. He has discovered that *alcohol*, saturated with *oleum terebinthinæ æthereum*, quickly and totally dissolves them. And induced by the powerful action of this *menstruum* out of the body, he has administered it internally with some degree of success; and is desirous of recommending it to the trial of others. Such a remedy, if it prove effectual, must be regarded as a valuable addition to the *materia medica*. But if we consider the peculiar œconomy observed by nature, in the circulation of the blood through the liver; the long stagnation of the bile in the gall bladder; and the quickness with which *alcohol* and oil of turpentine pass off by urine and perspiration, it is to be feared that such a *menstruum*, powerful as it may be, will scarcely reach the solvend. To this objection, also, we may add, that the diagnostics of the disease are often obscure and uncertain. The same gentleman informs me, that
he

he was not long since present at the dissection of a woman, who had laboured several months under an obstinate jaundice, attended with violent and periodical pains in the region of the liver, with costiveness, white stools, and other symptoms of biliary concretions. No such cause however was found; but a large schirrus extended itself from the *pylorus* along the *duodenum*, so as to close the orifice of the *ductus communis*, and thus prevent the passage of the bile into the intestines.

PROPOSALS FOR ESTABLISHING MORE ACCURATE,
AND COMPREHENSIVE BILLS OF MORTALITY, IN
MANCHESTER.

THE establishment of a judicious and accurate register of the births and burials, in every town and parish, would be attended with the most important advantages, medical, political, and moral. By such an institution, the increase or decrease of certain diseases; the comparative healthiness of different situations, climates, and seasons; the influence of particular trades and manufactures on longevity; with many other curious circumstances, not more interesting to physicians, than beneficial to mankind, would be ascertained

certained with tolerable precision. In a political view, exact registers of human mortality are of still greater consequence, as the number of people and the progress of population in the kingdom, may, in the most easy and unexceptionable manner, be deduced from them. They are the foundation likewise of all calculations concerning the values of assurances on lives, reversionary payments, and of every scheme for providing annuities for widows, and persons in old age. In a moral light, also, such *tables* are of evident utility, as the increase of vice or virtue may be determined, by observing the proportion which the diseases, arising from luxury, intemperance, and other similar causes, bear to the rest; and in what particular places distempers of this class are found to be most fatal.

A FEW examples may perhaps confirm and illustrate these observations. In the Pais de Vaud, a district of the province of Bern in Switzerland, and in a country parish in Brandenburg, 1 in 45 of the inhabitants dies annually; and at Stoke Damarrell in Devonshire, 1 in 54; whereas in Vienna, and Edinburgh, the yearly mortality appears to be 1 in 20; in London 1 in 21; in Amsterdam and Rome 1 in 22; in Northampton 1 in 26; and in the parish of Holy Cross, near Shrewsbury, 1 in 33. In the Pais de Vaud, the proportion of inhabitants, who attain the age of eighty, is 1 in $21\frac{1}{2}$; in Brandenburg 1 in $22\frac{1}{2}$; in Norwich 1 in 27;
in

in Manchester 1 in 30; in London 1 in 40; and in Edinburgh 1 in 42. These facts afford a striking but melancholy proof, of the unfavourable influence of large towns on the duration of life. From the most accurate computation, London is found to contain 601750 inhabitants; and from 1759 to 1768, the burials have exceeded the christenings every year upwards of 7000; which is the recruit the metropolis requires annually from the country, to support the present number of its people. In 1757, a survey was made of Manchester and Salford. The number of inhabitants then amounted to 19839; and the burials, exclusive of those amongst Dissenters, were 778. But since that time the populousness of Manchester has considerably increased. Half of all that are born in this town die under five years old. The island of Madeira is so remarkably healthy, that two thirds of all who are born in it live to be married. Autumn is the most healthy, and summer the most sickly season there. The mortality of spring and summer is to that of autumn and winter, as 115 to 100. In Manchester, diseases are most frequent and fatal in the months of January, February, and March; and least so in July, August, and September. The mortality of these two seasons is as 11 to 8; and of the first six months of the year, compared with the last six months, as 7 to 6. M. Muret, Secretary to the Œconomical Society

Society at Bern, informs us, that he had the curiosity to examine the register of mortality in one town, and to mark those whose deaths might be imputed to intemperance. And he found the number so great, as to incline him to believe that drunkenness is more destructive to mankind than pleurifies, fevers, or the most malignant distempers (*d*). Such are the important uses, to which Tables of Human Mortality have been applied.

THE following plan of a more exact and comprehensive register, than has hitherto been kept, is submitted to the consideration and correction of those who undertake the charge of the BILLS of MORTALITY in *Manchester*.

I. LET a table of *christenings, marriages, and burials* be kept in every church, chapel, and place of religious worship in the town, and delivered at certain stated times, to the Clerk of the parish church, to be formed into one general BILL, and quarterly or annually published. It is of importance that the *still-born* children, and those who die before *baptism*, should also be registered; and the midwives should be desired to deliver an

(*d*) See a very valuable Treatise on Reversionary Payments, by the Rev. Dr. Price; the Bern Observations for the year 1766; Philosophical Transactions, vol. LVII. and LIX; and Dr. Short's new Observations.

account of them. Perhaps the Sextons may assist in ascertaining their number, as they are usually interred in church yards, or other public burial grounds.

II. LET the table of *christenings* specify the *males* and *females* who are baptized; and the table of *deaths* express the *males* who die, under the several denominations of children, bachelors, married men, and widowers; the *females* who die under the corresponding denominations of children, maidens, married women, and widows. An observance of these distinctions will determine the comparative number of *males* and *females* who are born; the difference between the sexes in the expectation of life; and the proportion which the annual births, deaths, and marriages bear to each other. Thus by the BILLS of MORTALITY which have been kept at Vienna, Breslaw, Dresden, Leipzig, Ratisbon, and other towns in Germany, it appears that the proportion of *males* to the *females* who are born is as 19 to 18: But the proportion of *boys* to *girls*, who die under ten years of age, is as 7 to 6; and of *married men* to *married women*, in Breslaw, as 5 to 3; in Dresden, as 4 to 1. At Vevey, in Switzerland, for twenty years, ending in 1764, there died in the first month 135 *males* to 89 *females*; and in the first year 225, to 162. The same accounts shew likewise that, both at Vevey and Berlin, the *still-born*

born males are to the *still-born females*, as 30 to 21. In the parish of Holy Cross, Salop, an account was taken by the Vicar, A. D. 1760, of the number of *males* and *females* of the age of seventy and upwards: The latter amounted to *thirty-five*, the former only to *eight*. At Paris, and in Sweden, it has been observed, that *women* not only live longer than *men*, but that *married women* live longer than *single women*. And in Switzerland it appears particularly, from the calculations of M. Muret, that of equal numbers of *single* and *married* women, between the age of 15 and 25, more of the former died than of the latter, in the proportion of 2 to 1 (*e*).

LET the ages under *five*, be specified by single years; and afterwards, by periods of five or ten years.

IV. LET the BILLS OF MORTALITY contain not only a list of the diseases of which all die, but also express particularly the number dying of each disease, in the several divisions of life, and different seasons of the year. To accomplish this, it will be necessary for the physicians of the town to consider the present list of distempers; to reject all synonymous and obsolete terms; and to give a short and easy explanation of those which

(*e*) Vid. Dr. PRICE's Observations on Reversionary Payments.

are retained. And whenever a person dies, who has been attended by any of the faculty, the physician, surgeon, or apothecary should be desired to certify, in writing, the age and distemper of the deceased.

THE following TABLES are constructed upon this PLAN ; and if the scale be enlarged, will serve for the *Church Register*, as well as for quarterly or annual publication. It appears to be unnecessary, and in many instances would be exceptionable, to insert the names of the deceased: Their *denomination* and *disease* therefore may be expressed, in the columns allotted to each, by dots or units, which are to be summed up at the end of every three months, and set down in figures.

The LISTS of *Marriages* and *Christenings* may be kept in the common method.

THE additional trouble, which this more comprehensive and accurate REGISTER will occasion to the Clerks of the several churches, &c. may be compensated by distributing amongst them, at the discretion of any judicious clergyman, the money which arises from the sale of the quarterly BILLS. If a hundred of these be subscribed for, or sold at the price of one shilling each, the sum of twenty pounds per annum will thus be raised, without imposing any new burdens on the town. Every second, third, fourth, or fifth year, the bills may be collected into a volume, and published,

lished, under the direction of two or more physicians, with observations on the state of the weather, the prevalence of epidemic diseases, their symptoms and method of cure, and the increase or decrease of population during that period. Such a work will afford the most important instruction to the public ; and from the profits of it, a fund may be established for the benefit of the Clerks, and the support of the institution.

N. B. It is obvious that the plan here proposed is not local, and that it may be executed, with equal facility and advantage, in every town and parish in the kingdom. BILLS of MORTALITY might be rendered more useful in a political view, by taking sometimes the number of houses and inhabitants, under and above particular ages, wherever such registers are established.

I.
T A B L E of D E A T H S.
January, February, March.

Ages.	Males,	Females,	Ages.	Bachelors.	Married Men.	Widowers.	Maidens.	Married Wo- men.	Widows.
1.			20.						
2.			25.						
3.			30.						
4.			35.						
5.			40.						
10.			45.						
15.			50.						
Total under 15.			60.						
			&c. &c.						

ii.

TABLE of DISEASES.

January, February, March.

[illegible]

P R O P O S A L S

FOR ESTABLISHING MORE COMPREHENSIVE AND ACCURATE

P A R I S H R E G I S T E R S ;

Communicated by the Rev. Mr. DADE, of YORK.

RALPH BIGLAND, Esq. Norroy King at Arms, observes, in his pamphlet published a few years ago, that “ the necessity of proper
“ records for ascertaining the marriages, births,
“ baptisms, deaths and burials of persons within
“ their respective parishes, is abundantly evident
“ from a transient view of our ancient history,
“ which, for want of proper names, and real dates,
“ and family connections occasionally to be re-
“ ferred to, is oftentimes rendered perplexed and
“ unintelligible, and sometimes altogether incon-
“ sistent even with its own chronology.”

To remove this defect, Thomas Cromwell, afterwards Earl of Essex, being the King's Vicar General, in the year 1338 issued out an order to the clergy throughout England, that in their respective parishes a public register should be kept
for

for the above purposes. How far the intentions of that Minister of State are really answered, is evident from the incorrect manner in which entries are too generally made. It has been long wished that the utility of parish registers was thoroughly investigated, that the defects in making the entries were pointed out, and such a plan laid down, as might not only be useful, but easily applied to practice.

WHETHER the present form, with the observations upon it, contribute to elucidate any of these points, the public will easily determine.

EACH page is divided into six columns; *the first*, in the register for baptisms, contains in large characters the christian name: in the *second column* is the surname and seniority of the infant, also in large characters. The utility of this disposition will appear to any person who has examined parish registers with a degree of accuracy. Lest the object of our inquiry should escape us, how frequently are we obliged to undergo the toil of traversing every line in each page, written perhaps in small characters, improperly spelt, and in a hand sometimes scarcely legible; whereas according to the present form, the reader will be able, with one glance of the eye, to run over the several names in each page; and will examine, in a few minutes, what otherwise would take several hours to accomplish.

IN the present form it is hoped that care has been taken to identify the persons: for when we are told that Robert Lutton, James Creyke, and Elizabeth Dealtrey were baptized; or that William Strickland, Mary Strangways and Richard Heblethwayte were buried on such a day, in a succession of years, how shall we inform ourselves whether the parties were infants, adult, or aged, married or single, of what profession, or how they stood related; circumstances we are too apt, at the time of recording those particulars, to think of no moment, because their consequences are remote. Nor are our inquiries more gratified in finding John son of William Fairfax, Mary daughter of Thomas Beckwith, and James son of Robert Anderson, baptized; or Mr. John Grimston, Mrs. Jane Turner, and James son of William Fountaine were buried on such a day. Was there no necessity for carrying our researches further than twenty or thirty years, the defect might be supplied by the testimony of living witnesses, though perhaps, even then, not without much trouble and inconvenience; but where it happens that the occurrences are not recent, and there are no collateral circumstances to assist us in identifying the parties, we must naturally be left in the dark. A gentleman in the West-Riding of Yorkshire, some years ago, felt the full weight of this defect. Being desirous of forming a
genealogical

genealogical account of his family, he applied to the register of the parish; and though he collected nearly 100 baptisms, and as many burials in the last century, there was not one circumstance that would enable him to digest them into any form, and to ascertain the respective branch to which each party belonged. Where families of the same name reside within the same parish, there will arise difficulties in proportion; and after the expiration of half a century, it will be impossible to distinguish the descendants of one house from those of another. There lived some years ago, in the neighbourhood of Thirsk, three respectable families, nearly allied, of the name of Kitchingman; and on examining the parish register, I find it verifies my assertion.

MR. BIGLAND had his eye upon these defects, when he observes, “it is of importance to every family, not excepting the least considerable, to pay some regard to their pedigrees, and consequently that every circumstance, whether of a public or private nature, that tends to illustrate genealogical intelligence, should be attended to with the most religious exactness.”

LET us then view the last mentioned names, registered according to the form, at the end of these remarks. With the addition of collateral circumstances, we shall easily distinguish the object of pursuit, whether it may regard the title of our property,

property, or only the gratification of an inquiry natural to those who are desirous of knowing whence they are descended. We have therefore allotted the *third column* to the name, profession, and descent of the father, and the fourth to the name and descent of the mother, the particulars of which may easily be collected when the infant is baptized. Thus shall we hope, on trials of titles to estates, and genealogical inquiries, to raise a fund of intelligence to the industrious antiquary, as well as the gentlemen of the law; and perhaps they may allow this scheme to bid the fairest for supplying the place of visitations or inquiries *post mortem*.

THE *fifth column* shews the birth, and the *sixth* the baptism of the infant; the entry of each being essentially necessary. When the age bears date from the baptism only, the child may become subject to great inconvenience. Let us illustrate this suggestion.

A PERSON leaves £5000 to a distant relation, in case his son should die in his minority. It seems, from the remembrance of creditable neighbours, that the child was certainly born a fortnight before baptism, that he married in his minority, and died a week under age according to the date of the baptism, being survived by his wife and an infant son. The parents and witnesses of the birth being dead, and no particulars found sufficient

cient to ascertain the precise day of his birth, the entry of the baptism is admitted as evidence, and the distant relation possesses the fortune, to the great prejudice of a poor relict and her helpless child.

IN parishes of vast extent, where families dwell at a great distance from the church, the winter floods and other accidents frequently delaying the baptism of the infant, it is not uncommon to see children brought to the font at three, four, and six months old; nay upon the moors, and in other remote parts, we have instances of children receiving baptism, aged almost as many years: a most essential reason this, why the birth of infants should be carefully registered, as well as the day of baptism. For it should be considered, that under the age of twenty-one years, a person cannot marry without consent of parents or guardians, take his freedom in any corporation, vote at an election, be a Representative in Parliament, or, in short, fill many important offices in society: and may it not happen, from a concurrence of circumstances, that persons really of that age may be deprived of such benefits, and lose some great and valuable privileges? If then the entry of the birth, as well as baptism, will be admitted as evidence, and effectually prevent such ill consequences, what pity it is that the birth is so frequently omitted? It is somewhat remarkable that a gentleman, who was almost the first person that did me the favour to inspect the present form,

and

and whose family is distinguished for an ancient residence upon their property, in the neighbourhood, told me that his baptism was registered at O——, but that after the strictest inquiries he never could be informed *when* he was born.

WHAT has been observed on the page for baptisms, will serve to illustrate that for the burials: and as an affection for the memory of those we loved prompts us to a desire of mingling our ashes with theirs, I have been particular in ascertaining the place of interment.

I HAVE only to add, that the uniformity of the page has been consulted, and that the *two last columns*, in the register of burials, are intended to distinguish places remarkable for longevity, or the reverse, and to acquaint us what disorders mankind is subject to under particular seasons and climates; the use of which information is sufficiently evinced by Dr. Percival of Manchester.

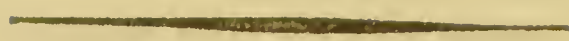
SHOULD this form meet with the approbation of the public, I can claim no other merit than having improved upon a hint, given to the community in the year 1715 by Mr. Thoresby, the ingenious author of *Ducatus Leodienfis*, or the *Topography of Leeds*, as proposed to him by an eminent Antiquary, Thomas Kirke, Esq. of Cookbridge near to that town.

Infant's Christian Name.	Infant's Surname and Seniority.	Father's Name, Profession, and Descent.	Mother's Name and Descent.	Born.	Baptized.
J O H N	FAIRFAX, First born of	William Fairfax, of Steeton, Esq. 3d. son of Sir William Fairfax of Denton, Knight. By Mary, eldest daughter of Hugh Cholmley of Whitby, Esquire.	Mary, only daughter of Sir Walter Bethell, of Ellerton, Knight. By Jane, daughter and coheirefs of William Sotheby, of Birdfall, Esq.	On Monday the 24th of January.	On Sunday the 30th of January.
M A R Y	BECKWITH. Second daughter of	Thomas Beckwith, counsellor at law, on Friar Wall, only son of the late Roger Beckwith of Ripon, Gent. By Jane his second wife, daughter of John Hungate, of Saxton, Esq.	Margaret, daughter and heirefs of John Darley, of Buttercramb, Esq. By Frances his first wife, daughter of John Milner, of Tadcaster, Esq.	On Saturday the 22d of January.	On Wednesday the 16th of February.
J A M E S	ANDERSON, Fourth son of	John Anderson, Apothecary, in Castlegate, youngest son of James Anderson of Brigg com Linc. Gent. By Frances, daughter of William Saltmaith, of Howden, Gent.	Sarah, late relict of William Ramsden, rector of St. Martin's in the Fields, London, and daughter of Samuel Dixon, Alderman, of Leeds, deceased.	On Tuesday the 22d of February.	On Saturday the 19th of March.

BURIALS AT ST. MARY'S, CASTLEGATE, FOR THE YEAR 1774.

Christian Name.	Surname	Descent, Profession, and Abode.	When died, and where buried.	Age.	Distemper.
JOHN	GRIMSTON.	Doctor of Physic, a married man, fourth son of John Grimston, of Grimston Garth, in Holderness, Esq. By Charlotte, second daughter of John Wilson, Recorder of Hull.	Died at his house without Monk Bar, on Sunday the second of January, and buried in the vault under the altar on Friday the 7th of January.	56 years.	Apoplexy.
JANE	TURNER.	Relict of Oliver Turner, of Wakefield, Gent. eldest daughter of the late Samuel Palmes of Naburn, Esq. By Isabel, daughter of James Strickland, of Thornton Bridge, Gentleman.	Died at Wakefield on Tuesday the 8th, and buried on Saturday the 12th of February, in the centre of the fourth aisle.	47 years.	Pulmonary Consumption.
JAMES	FOUNTAIN.	Bachelor, and portrait painter in Coppergate, only son of William Fountain of Thirsk, woollen-draper. By Jane Stonehouse, his wife.	Died on Wednesday the 16th, and buried on Sunday the 20th of March, in the church-yard, under the east window of the chancel.	25 years.	Fever.

* * * This improvement may be extended to the register for marriages, and the form, as established by an Act of Parliament, will in general allow room sufficient for inserting the descent of each party.



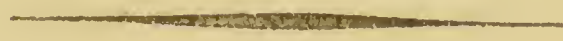
O B S E R V A T I O N S

A N D

E X P E R I M E N T S

O N T H E

P O I S O N O F L E A D.



ADVERTISEMENT.

THE excellent Treatises of Sir George Baker, on the POISON OF LEAD, first excited the author's attention to the subject; and to him the former edition of this little work was inscribed. The approbation of so able a judge is at once a sufficient motive and apology for offering it again to the public.

OBSERVATIONS AND EXPERIMENTS

ON THE

POISON OF LEAD.

SECTION I.

THE public has been lately favoured with several valuable treatises on the subject of Lead, which reflect equal honour on the learning, ingenuity, and benevolence of the author.* His observations on its ready admission into, and injurious operation on the human body, are highly interesting and important; and clearly evince that many chronic, as well as acute diseases, proceed from this mineral poison, when such a cause is unsuspected.

NOR is the action of Lead confined to the human species: It exerts alike its deleterious powers on quadrupeds and birds.

A GENTLEMAN in Staffordshire used to feed his hounds in troughs lined with Lead, and they

* Dr. Baker, now Sir George Baker, Bart.

never hunted but three or four of them fell down during the chase, convulsed, and seemingly in agonies of pain. A friend suggested to the owner of the dogs, that these convulsions might possibly arise from some portion of Lead dissolved in their food. The leaden troughs were, therefore, removed, and the hounds, from that time, were entirely free from this disorder. Another instance, of a similar kind, was related to me by a country gentleman who resides in Derbyshire.

AN intelligent Plumber in Manchester assures me, that he is unable to keep a cat in his house above a month or two. The animal soon sickens, becomes rough in its coat, listless, emaciated, and dies in a short time of a *marasmus*. These symptoms he ascribes to the particles of Lead scattered upon the floor of his work-shop, which adhering to the feet of the cat, and being licked off, are swallowed, and exert their virulent powers immediately on the stomach and bowels. A person of the same business, and of good credit in Sheffield, has observed that cats are fond of the sweet powder with which the surface of Lead is generally covered; and that they are affected by it in the manner just described: But he adds that they are sometimes driven to the most outrageous madness; and that he has cured many of these animals, when labouring under the most frightful symptoms, by pouring sweet oil into them.

AN ingenious apothecary, whose house is contiguous to a Plumber's shop, has more than once observed appearances of the *colica pictonum* in his cats; and some of them have become quite frantic with pain.

A RED LINNET, very lively and in perfect health, and which had been long used to confinement in a cage, was placed in a parlour, recently painted with white Lead. The bird soon sickened, continually gasped for breath, and died in a few days. Another bird of the same species, and equally healthy, was then purchased to supply its place. This was presently affected in a similar manner, and died in less than a week.

A LADY, who is attentive to the feeding of her poultry, had troughs of Lead made for them, on account of their being more durable and cleanly. After the use of these she observed that her fowls and chickens became sickly, spiritless, and emaciated. The food she gives them consists of bread, potatoes, barley, &c. mixed with butter-milk. The latter ingredient is a powerful solvent of Lead; and thus poison is mingled with their nourishment.

A NUMBER of ducks and geese, the property of a painter, were all killed by being confined, a single night, in a place supplied with the water in which his brushes had been steeped, to prevent their becoming dry.

SATURNINE preparations are now almost universally employed in surgery; and from their astringent, antiseptic, and sedative powers, are justly classed in the first rank of topical remedies. But Mr. Goulard strenuously maintains, that the external use of Lead is *never* attended with any of the pernicious effects of its internal exhibition. And we have the concurring testimony of his very ingenious commentator to these facts (*a*). The evidence of these gentlemen seems to be further corroborated by the experience of the faculty at Chester, on a late melancholy occasion. November 5, 1772, a large number of people, assembled at a puppet show, were blown up by the accidental explosion of gun-powder, placed underneath, in a grocer's warehouse. The sufferers, admitted into the Infirmary, were in number fifty-three, not one of whom escaped without violent marks of contusion, or large and deep burns in different parts of the body. They were all repeatedly washed with Goulard's saturnine water, which in every instance seemed to produce the most salutary effect. And though the circumstances of these unhappy patients appear to

(*a*) Vide Mr. Aikin's Observations on Preparations of Lead, page 10.—My friend Mr. White, who uses large quantities of the Extract of Lead both in his private, and hospital practice, entertains the same opinion with Mr. Aikin, of its innocency, and efficacy.

have

have been peculiarly favourable to the absorption, as well as to the immediate action of this mineral poison on the nervous system, no symptoms afterwards occurred, which could reasonably be imputed to its operation. Three of the sufferers, indeed, died of the locked jaw; but this disease, with sufficient probability, was ascribed to the bruises which they received about the joints. Strong as this evidence may be esteemed of the innocency as well as efficacy of Lead, externally applied, I am still inclined, with Dr. Baker, to believe that it *sometimes* produces its specific effects upon the body; and the following cases, though not decisive, will at least shew that my opinion is not entirely without foundation.

THREE years ago a young man had a tumour of the spine, which had resisted various discutient remedies. An emollient cataplasm, mixed with the *extractum saturni* of Goulard, was applied. In a few hours he was seized with violent pains in his bowels, and severe cramps in the extremities, which ceased soon after the cataplasm was removed.

A GENTLEWOMAN, in August 1770, was overturned in a chaise, and thrown on the side of her head and shoulder; the muscles of which were much bruised and strained, but the *humerus* was neither fractured nor dislocated. She was immediately bled, and the venæsection was re-

peated the next day. A saturnine fomentation was applied warm to the parts affected, and frequently renewed. Twitchings in the legs ensued, and afterwards spasms in the stomach. The fomentation was omitted, and these symptoms ceased; nor did any other application produce the like effect. This lady is subject to the colic; but as she was ignorant of the specific action of Lead, the spasms in her stomach cannot be imputed to the force of imagination.

THE governor of the work-house in Manchester, aged upwards of seventy years, had a large ulcer in his leg, which was washed several times in the day with the saturnine water of Goulard, and then covered with an emollient poultice, which contained a small quantity of the extract of Lead. After using these applications four days, he became affected with the colic, and also with paralytic symptoms, which though slight in degree, could not fail to be alarming. The preparations of Lead were therefore discontinued, a dose of *oleum ricini* was administered, and he soon recovered from these adventitious complaints.

A LADY of a delicate habit, and the mother of four children, soon after delivery, to avoid being a nurse, rubbed her breasts with oil in which litharge and red lead had been boiled. Her milk was by these means repressed; but in a short time she began to complain of acute pain about the stomach and duodenum, loss of appetite,

tite, flatulency, and depression of spirits. Opium and the warm bath were the only remedies that afforded relief. Whether these complaints arose from the recession of the milk, or were occasioned by the poisonous action of the calces of Lead, I leave to the decision of my reader.

IN June 1757, a physician of great humanity, was desired to visit a woman who had a varicose swelling of the veins of the right foot, attended with great pain, swelling, and inflammation. He directed a solution of *saccharum saturni* and opium, in elder flower water, to be frequently applied, by means of linen rags, to the part affected. The pain was alleviated, the swelling diminished, and the redness soon disappeared. But in a few days severe vomitings, a violent colic, and obstinate constipation of the bowels supervened; and the woman was ever afterwards subject to frequent returns of these complaints. The saturnine solution was used only four or five days; nor was it then discontinued from any suspicion of its injurious effects. For very little attention was at that time paid to the noxious qualities of Lead.

I HAVE been assured, from undoubted authority, that Dr. A—— had a slight paralytic affection of his legs, by the practice of setting his feet every evening, on a piece of Lead placed near the fire. And that a dog, by lying on it, was entirely deprived of the use of his limbs.

ZELLER mentions a remarkable instance of the pernicious effects of litharge, which Dr. Baker has quoted. *De Lithargyro quoque mihi narravit, matronam quandam nobilem pulverem ejus, in rubore faciei, postquam hic ipsi tanquam singulare et certissimum arcanum deprædicatus fuisset, in petia ligatum, axillis bis vel ter die aspersisse cum presensim effectum; verum exinde subsequuta fuisse dyspnæam, lipothymiam, dolores vagos in abdomine, vomitionem, et nauseam.* This account the doctor has confirmed by the case of a violent and obstinate colic, which appeared to be occasioned by some litharge mixed in a cataplasm, and applied to allay a troublesome itching (*b*). The testimony of Boerhaave must also be admitted to have great weight on this subject; and he seems to speak from experience, when he says, after describing the process for making vinegar of Lead, “ This
 “ preparation, if rubbed upon the skin, in a state
 “ of dilution, cures eruptions, redness, the erysi-
 “ pelas, and inflammations; gives whiteness and
 “ beauty to the skin, but proves injurious to the
 “ body, at length occasioning a consumption, as
 “ appears by many melancholy examples (*c*).”

(*b*) Medical Transactions, vol. I. p. 312.

(*c*) “ Si dilutum corpori affricetur, pustulas, rubedines, erysipelas, phlegmonas multum levat; cuti candorem, nitoremque conciliat; sed corpori nocet, tandem in phthisin deducendo, ut tristissimis sæpe constitit exemplis.” Element. Chemiæ, vol. II. Proc. 172.

SECTION II.

THE following observations concerning the effects of Lead I have collected in Derbyshire. There are many mines of this ore, from the working of which no inconvenience ensues (*d*). But the case is otherwise where the vein of ore is narrow, and the lime stone sides are very hard; for then the small particles of the ore, which fly off from the tool by the force employed in digging it, fall upon the faces of the workmen, and are frequently received into their mouths. The same is true, also, of the mines in which the water runs through the ore; for the faces of the men are continually sprinkled with it, by the dashing of the pick-axes, and they look as if rubbed over with gun-powder. To render the ore fit for sale it is broken, and carefully washed from the impurities which adhere to it. If any cattle drink of the water which has been used for this purpose, they are affected with violent colics, and constipation of the belly; and they generally die convulsed. Dogs and cats, from the same cause, will sometimes become

(*d*) THE Earl of Hopetoun informs me that his miners in Scotland are, in general, a very healthy set of men.

mad, fall into fits, and often kill themselves by running headlong against a wall.

THE *colica pictonum* is more incident to those employed in the smelting of Lead, than to the workers in the mines. But since cupolas have been used for that operation, it has prevailed much less than formerly, even amongst this class of men. For the vapours arising from the Lead are thus carried off, by a strong current of air, through a chimney, which is raised many yards above the furnace. These vapours destroy the verdure of the grass, which grows in the neighbourhood of the smelting houses; and the cattle which feed on it are sometimes affected with the dry gripes, or, as it is vulgarly termed, the belland. But the most frequent cause of this disorder amongst horses and cows, is the grazing in pastures, which have been overflowed by floods from the mines. And it is remarkable that these animals, who are generally directed to avoid whatever is injurious to them, by an instinct wise and unerring in its operation, so far from being averse to this mineral poison, are fond and even greedy of it to excess. The same is true also of pidgeons, and other tame fowls, who pick up the small particles of Lead whenever they meet with them. Sheep are seldom known, in Derbyshire, to be affected with the belland.

I AM indebted to an experienced and judicious practitioner, who resides at Bakewell in Derbyshire, for the following information concerning the usual method of treating the *colica Piætonum*, amongst the workers in Lead. The men first complain of a weight, pain of the stomach, and costiveness, which are generally relieved, if they apply early for advice, by a vomit, and pills of soap, rhubarb, and aloes; or by any aperient medicines of the liquid kind, with oil added to them. But if these symptoms be neglected, the patients complain of their saliva becoming sweet, of clammy sweats, lassitude, feebleness of the legs, a total loss of appetite, obstinate costiveness, and a fixed pain in the abdomen, with severe retchings. In this stage of the disorder, oily clysters and gentle purgatives are the most effectual remedies; and are usually repeated at short intervals, till the stools assume a natural appearance. For during the disorder they are hard, dry, and scaly like bran. The *oleum ricini* has of late been used with great success.

I CANNOT omit this opportunity of recommending the trial of alum, both as a prophylactic, and as a remedy in slighter cases of the *colica piætonum*. I have administered it with the happiest effect in various obstinate and painful affections of the bowels. Fifteen grains given every fourth, fifth, or sixth hour, for the most part

part prove gently aperient; and if the symptoms be not very severe, the second or third dose seldom fails to mitigate the pain, and sometimes entirely removes it. When there is reason to apprehend that the alum may be too rough or austere in its action, it may be combined with gum arabic, or sperma ceti; and under this form it is most likely to be serviceable in the colic arising from Lead (*e*).

IN Derbyshire, when the miners or smelters of Lead find themselves affected with the asthma, they usually leave their occupation for a while, and work at the lime kilns, experience having taught them that the fixed air, or *mephitis*, arising from the calcination of lime stone, is an effectual and speedy remedy in this disorder. No other change of employment affords them so much relief. The same vapour, in a moderate degree, seems to be salutary to the human constitution; for I have been informed by a gentleman of judgment and veracity, who has the direction of a considerable number of lime kilns, that the men employed in burning lime are remarkable for their health and longevity. This observation is the result of more than thirty year's experience; and perhaps may corroborate the popular opinion,

(*e*) See Cases of Colics, cured by the Use of Alum, p. 401.

that in consumptions of the lungs it is good to live near places, where this process is carried on.

It is the common practice of the smelters of Lead, and of others, also, who live in the neighbourhood of smelting mills, to broil mutton, beef, or pork steaks on the hot pigs of that metal, by which the flesh acquires a peculiarly agreeable flavour. It is probable the flavour depends upon the sweetness communicated by the effluvia of the new-cast Lead; but however grateful to the palate, it must be injurious to the nervous system. A Clergyman, at Bakewell, who was fond of fishing, and often used to broil his fish in this way, was affected, during several years before his death, with colics, frequent retchings, and a total loss of appetite. His disorder was ascribed to an irregular gout; but the apothecary who attended him is now of opinion, that it was produced by the dangerous practice above mentioned; to the consequences of which he was then a stranger.

THE river Derwent flows through a large tract of Derbyshire, which abounds with Lead mines; and the streams discharged from many of them, and which are loaded with particles of Lead, fall immediately into it. Yet it is stored with trout and other fish, and the water of it is potable, and not esteemed unwholesome. But I have often remarked, that the trout caught in the Derwent

near Matlock, are of a smaller size, of a softer texture, paler colour, and of a less agreeable flavour than those of other rivers. And I am inclined to impute this to the action of Lead; because the same kind of fish are found in great perfection in the river Trent, into which the Derwent flows, after a passage which allows time for the precipitation of the ore which it contains. The following fact also, if it be deemed sufficiently authentic, confirms my opinion. It is related in a letter from Dr. Carte, of Manchester to Dr. Grew, of which I shall insert a copy in the Appendix, that the reader may determine the degree of credit which is due to it. “ I know
 “ a small rivulet, on which some of these mills
 “ stand, wherein trouts have been caught which
 “ have been supposed affected with the bellan, by
 “ the irregularity of their growth, their heads
 “ being great and misshapen, their backs crooked,
 “ their tails very small, which I am apt to think
 “ might proceed from their feeding on the
 “ smitham or dust that is washed down at a flood:
 “ For not only the fumes, but also the washings
 “ of the Lead ore, and the waste (as they call it)
 “ i. e. the dust that remains after the ore is melted,
 “ is very noxious to most sort of creatures, and
 “ for this reason, they that live near the mills
 “ dare not water their horses at the river upon
 “ a flood.”

THE manufacturers of the White and Red Lead Works in Sheffield, are frequently and violently disordered; but they seldom apply to the faculty for assistance, because they have certain popular remedies amongst themselves, which are chiefly of the laxative kind. Some of these workmen, when labouring under complicated affections of the lungs, stomach, and bowels, have been speedily relieved by a dose of emetic tartar, sufficient to operate both as a vomit and purgative. And a blister, applied to the abdomen, has also been known to remove a very severe colic, arising from the same poison.

THE composition called by braziers pot-metal, because pots for boiling food are made of it, consists of nearly equal parts of copper and lead, with a small proportion of litharge and of antimony. Brass cocks are, also, made of the same materials. The heat necessary for fusing this composition is much greater than what is usually employed by plumbers, and sufficient to evaporate Lead very copiously; and this evaporation is much increased by the flux which is often employed. The workmen, in these two articles, use few or no precautions excepting chimneys that draw well, but they are unavoidably exposed to the noxious vapours every time they pour the metal into a mould. Yet I have heard, from good authority, that not above one in forty of these

these artists becomes considerably diseased, in the manner supposed to arise from Lead; although a few of them are sometimes most violently afflicted with colics and palsies. Indeed there seem to be certain constitutions very little disposed to be affected by this mineral poison, either externally or internally applied. Two cases have been communicated to me, of the vinegar of Lead being swallowed in no inconsiderable quantity, without prejudice. It proved in the one instance powerfully diuretic; in the other it produced no sensible effect.

A PHYSICIAN, well known to the public by his useful and ingenious writings, informs me, that during his residence in the West-Indies, many cases fell under his observation which justify the utmost caution in the use of Lead, and of its preparations. In one of the small Virginia Islands near Tortola, a Gentleman who possessed many slaves, built a spacious house, which was covered with shingles, or wood cut into the form of tiles, and painted with red Lead. The rain that fell upon this roof, was conveyed by pipes into an open cistern of Lead, for the use of the family; the individuals of which had been peculiarly incident to violent, and sometimes fatal colics. The physician very justly attributed this disorder to the Lead carried off, by the rain, from the shingles, or corroded by the water in the cistern.

cistern. And he had afterwards the satisfaction to find, that those who refrained from this water were no longer liable to attacks of the colic.

A LEARNED friend of mine is of opinion, that the colic from Lead was more common amongst the ancients, than is generally suspected. Their drink, he observes, was chiefly wine of the acceſcent kind, which powerfully corrodes this mineral: And pains of the bowels were very general complaints, as appears from the writings of Celsus. Oil, also, both externally and internally, was the remedy prescribed in such cases; the efficacy of which is chiefly, if not entirely confined to the *colica pictonum* (f).

Two modern books of Cookery contain receipts for recovering wine when sour, and preventing it from becoming so, by means of ceruſſe, and of melted Lead. From one of these books, I have transcribed the receipt, which is as follows.

“ To hinder wine from turning.”

“ Put a pound of melted Lead, in fair water,
“ into your cask pretty warm, and stop it close.”

The Universal Cook, p. 244.

This work was published in 1773, and is written by John Townshend, late Master of the Grey-

(f) Celsus de Morb. Intest. tenuioris; Aretæus de Ileo;
& Cælius Aurelianus.

hound Tavern, and Cook to his Grace the Duke of Manchester.

IT must be supposed that Mr. Townshend is ignorant of the poisonous quality of Lead; but he is certainly deserving of censure for presuming to give receipts without better information. And if he, or other vintners have practised the method which he recommends, they are justly chargeable with all the mischiefs such detestable arts must produce. The adulteration of wine is indeed an evil so general, and so dangerous in its consequences, that it is to be hoped the legislature will interpose to prevent it.

IT may not be unseasonable here to suggest a caution, against the common practice of cleaning wine bottles with leaden shot. It frequently happens, I am persuaded, through inattention, that some of the shot are left behind; and when wine or beer is again poured into the bottles, this mineral poison will slowly dissolve, and impregnate those vinous liquors with its deleterious qualities. The sweetness (which is sometimes perceived in red port wine) may arise from this cause, when such an adulteration is neither designed nor suspected.

THE workmen in the sugar-house at Manchester are supplied with beer, prepared of malt and the refuse of the sugar, which are often fermented together in a large leaden cistern. The liquor
ferments

ferments so briskly, that without the utmost care it becomes foxed, or inclined to acidity; and the men who drank of it were formerly subject to the most severe and excruciating colics. Of late, proper measures have been taken to check the progress of the fermentation; and the sugar boilers, in consequence of this precaution, have been since exempt from those violent attacks to which they were before incident. Whether these colics were owing to a solution of Lead, or to the acidity of the wort, I shall not presume to determine.

A LADY of a delicate constitution, whose bowels are very irritable, always finds herself affected with the colic, if she sits half an hour in a room which has been lately painted. And a gentleman and his wife, by sleeping in such a chamber, a few years ago, were both violently disordered. The gentleman informs me, that when he first awaked, he felt a great oppression at his breast, a tremor, nausea, and a severe pain and great confusion in his head. By changing his apartment, these symptoms were in a short time happily removed.

S E C T I O N I.

EXPERIMENT I. **T**HE very beautiful polish of the Burslem pottery, commonly called the Queen's ware, inclined me to

suspect that Lead, which is easily vitrified with sand and kali, enters into the composition of its glazing. To determine whether my conjectures were well founded, I poured about an ounce and a half of vinegar upon a plate of this ware, that a large surface of the glazing might be exposed to the action of the vegetable acid. In twenty-four hours the vinegar had acquired a deeper colour, and assumed a dusky hue when two drops of the volatile tincture of sulphur were added to it. The same tincture, instilled into fresh vinegar in the like proportion, produced a light cloudiness, which was succeeded by a white sediment; the sulphur being precipitated by the combination of the acid and alkali. From this trial, which was several times repeated, it should seem that Lead is an ingredient in the glazing of the Queen's ware; but the quantity dissolved by the vegetable acid, appears to be very inconsiderable. For two drops of a solution of *saccharum saturni* (which I computed to be equal only to the fiftieth part of a grain of Lead) mixed with half an ounce of vinegar, struck a darker colour with the tincture of sulphur, than the same quantity of vinegar, after its action had been exerted upon the plate forty-eight hours.

THE present experiment, therefore, furnishes no objection to the common use of this beautiful pottery; but it shews that vessels of it are improper for the preserving of acid fruits and pickles.

EXPERIMENT II. I was a witness to the following experiment, when made by my friend Dr. Priestley, and have since repeated it. Several pieces of paper, daubed with white lead paint, were put under a receiver, which was then immersed, about two inches deep, in a vessel of water. In twenty-four hours the air was diminished more than one fifth part in quantity, and was become in a high degree noxious. It extinguished a candle, did not effervesce with nitrous air (*g*), and affected a mouse in such a manner, as must quickly have proved fatal, if the animal had not been immediately withdrawn. This air was rendered wholesome by agitation in water; which shews the propriety of placing vessels of water in rooms recently painted. Perhaps sprinkling water by means of a garden

(*g*) NITROUS air is obtained from all the metals and semimetals, except zinc, by the nitrous acid. When one part of this air is added to two parts of common air, the mixture becomes hot, turbid, and of a red colour, and suffers a diminution of nearly one third part of its bulk. These effects are observed to be exactly proportioned to the fitness of the air for respiration. With mephitic, inflammable, or any kind of noxious air, no chemical union is formed, nor any such changes produced by it. Hence the nitrous air furnishes a very accurate test of the comparative purity of other species of air. Vide Dr. Priestley's Papers on various Kinds of Air, which will be published in the LXVII. vol. of Philosoph. Transactions.

pot, would be still more effectual, because the surface is thus increased, and some degree of agitation produced.

EXPERIMENT III. I tried the same experiment with what the painters term *dead white*, which is a composition of white Lead, linseed oil, and spirit of turpentine. The result differed in no other respect, but in the proportional diminution of air, which was less in the present than in the former trial. Surprized at this circumstance, I repeated the experiment several times, but the event was uniformly the same. It is probable, therefore, that the oil of turpentine, by furnishing a cause of addition to the air, diminished the apparent destruction of it by the white Lead. This paint is found to be more injurious to the nervous system than any other, which may be explained by the action of the turpentine, in quickening and increasing the evaporation of the Lead.

EXPERIMENT IV. I exposed a very large surface of painter's oil to the air contained in a glass jar, immersed in water. In twenty-four hours the air was diminished in its bulk one fourth part, and instantly extinguished flame. Having no nitrous air in readiness, I could not employ this test. Painter's oil is prepared by boiling litharge and a small quantity of red lead, in the oil extracted from linseed.

EXPERIMENT V. I made a similar experiment with common linseed oil, and found that the air was neither diminished in quantity, nor rendered noxious in its quality.

EXPERIMENT VI. Having more than once felt myself disagreeably affected by the smell of an oil-case hood, I was desirous of trying whether this might arise from any thing injurious, communicated by it to the air. Several slips of fresh oil-case were, therefore, put into a receiver, which was then placed in water. The air in twenty-four hours extinguished the flame of a candle, and was diminished in quantity, but in what proportion I did not ascertain. Various compositions are employed for making oil case: But I believe they all contain Lead; and the most common one consists of *saccharum saturni*, gum copal, and other resinous substances, which are boiled in oil, to the consumption of two thirds of the original quantity. I am informed by an artist in this branch of business, that he is never employed in the above preparation, without suffering a most violent head-ach. And I have lately had a patient, who laboured under a severe and obstinate colic, which seemed to be produced by the same poisonous effluvia. For previous to her disorder, and during the short intervals of it, she was assiduously employed in shaping and sewing several hundred oil-case hoods.

After a variety of remedies had been tried in vain, the cure of this patient was at last effected by alum, combined with spermaceti.

EXPERIMENT VII. Red sealing wafers are made of fine flour, the whites of eggs, isinglass, and a little yeast. They should be coloured with vermilion; but as red lead is much cheaper, I believe it is more frequently used. The common wafers certainly contain a large quantity of it, as any person may discover, by setting fire to a few of them, when stuck upon the point of a pin. For the surface of the wafers will be covered with an infinite number of the particles of Lead, which running together will fall down into a spoon, or whatever is held to receive them. Wafers are pleasant to the taste, and they are often held long in the mouth, and sometimes swallowed through inadvertence: I have seen children fond of eating them. It is of importance, therefore, to know that the coarser or common kinds are poisonous, and that it is very absurd œconomy to purchase such on account of their cheapness. The polished Irish wafers seem to contain no Lead.

A LADY in Cheshire had a favourite bulfinch, which was so tame as to be permitted to fly about the room; a liberty that seemed to improve both his health and plumage. The bird unfortunately picked up some scraps of wafers, which had been
left

left after sealing a letter. He soon lost his appetite and spirits, and in a few days pined away and died. Another bulfinch was procured, and when sufficiently tame, allowed the liberty which the former had enjoyed; but great care was taken to keep wafers out of his reach. However, by the inadvertence of a stranger in the family, who had been using them, a piece of one was left upon the table, which the bird immediately seized, and like the former sickened and died in consequence of it. Dr. Falconer, to whom I am indebted for these facts, adds that some time afterwards, a third bulfinch, belonging to the same lady, met with a similar fate.

DR. WALL of Worcester, to whose friendship I am under many obligations, has lately favoured me with the following case. “ I was some years
 “ ago called to the son of a plumber in this
 “ town, a child about two years of age, who
 “ had been remarkably healthy till this illness.
 “ He had been taken, a few days before I saw
 “ him, with violent pains in the bowels, attended
 “ with a fever, and convulsive motions in the
 “ limbs. These complaints had been attributed
 “ to worms, and several medicines had been
 “ given unsuccessfully. When I visited him first,
 “ I found him paralytic on one side, and deliri-
 “ ous. Upon inquiring into the cause of his
 “ disorder, and particularly whether the child had
 been

“ been used to go into the room where they
“ melted the Lead, I was informed that he did
“ frequently, and that it was a custom with his
“ maid to let him run barefooted along the sheets
“ of Lead, whilst they were warm, with which he
“ appeared to be much delighted. I did not
“ then hesitate to attribute his present disorder
“ to this cause.”

I HAVE some doubt whether the vapour of arsenic be so poisonous, as is commonly supposed; and if the reader will excuse the digression, I will lay before him the facts on which that doubt is founded. To solder works of silver filigree, and other delicate manufactures, a composition is used, of which arsenic is the principal ingredient. The solder is melted by the flame of a lamp, directed by a blow pipe; and this operation cannot be performed with due accuracy, but in a close room. The greatest part of the arsenic is evaporated by the blast and flame, and some part also of the rest of the solder. And the workmen must constantly breathe these vapours, because there is little or no current of air to carry them into the chimney. Yet the men appear to enjoy as good health, and to live as long as other artists who pursue their business in close rooms, and use lamps. Amongst other examples of the truth of this observation, I saw one lately in the manufactory at the Soho, near Birmingham:

ham: A man aged upwards of fifty, who has soldered silver filigree more than five and thirty years; has regularly passed from eight to twelve hours daily in his occupation; and is at present fat, strong, active, cheerful, and of a complexion by no means sickly. Neither he, nor his brother artists, use any means to counteract the effects of their trade.

A N

A P P E N D I X

T O T H E

O B S E R V A T I O N S O N L E A D.

EXTRACT OF A LETTER, FROM THE AUTHOR, TO
DR. DUNCAN OF EDINBURGH; ON THE EX-
TERNAL USE OF PREPARATIONS OF LEAD (*a*).

THOUGH I entertain a very high opinion of the usefulness of Saturnine preparations, externally applied, and frequently prescribe them, yet I am fully convinced that they *sometimes* produce the specific effects of Lead upon the body. And I could wish that more attention were paid to the operation of such topical remedies, especially when applied to constitutions to which we are strangers. There are, indeed, some habits that appear very little disposed to be affected by this mineral poison, of which I have given several

(*a*) Inserted in the Medical Comment, vol. III. p. 199.
examples

examples in my *Observations and Experiments on Lead*, and can now add two others. The first was communicated to me by Mr. Barker, surgeon in Bakewell; the second, by the late Dr. Small, an excellent philosopher, and a physician of great eminence at Birmingham.

Two smelters, who have worked *nineteen years* at the smelting mills, have constantly, during that time, toasted the cheese, and broiled the bacon, and other provisions which they used, on the hot pigs of lead, without the least apparent inconvenience. They are stout, healthy men, and have never experienced any pains in their bowels. And, as this method of dressing meat renders it remarkably sweet and palatable, Mr. Barker could not prevail upon them to discontinue it.

A GENTLEMAN, who had been long troubled with the heart-burn, discovered, from repeated trials, that his malady was relieved by swallowing a large quantity of saliva. To increase this secretion, he chewed, many hours every day, a piece of Lead, which being neither hard, friable, nor offensive to the palate, suited his purpose better than any other substance. This practice he continued many years, with great advantage, and without injury, in any respect, to his health.

But the same learned physician informed me, that he had seen three instances of the
fatal

fatal effects of Goulard's Extract of Lead externally applied. Two of the cases were incipient white swellings; the third was a tumour of a more uncommon kind. Each of the patients became paralytic, and two of them were convulsed several days before death. I lament that Dr. Small did not favour me, in his letter; with a more circumstantial relation of these cases; but his judgment and accuracy may be relied on with confidence.

FROM the present universal use of the Saturnine Water of Goulard, it may be thought surprizing that such melancholy examples, as these, do not more frequently occur. But this preparation happily contains so small a portion of Lead, that it is capable, in the most irritable habits only, of producing its peculiar effects. An ounce phial, filled to the brim with the *Extractum Saturni*, weighed sixty-five grains and a half heavier than the same quantity of the vinegar with which it was prepared. A hundred drops of this Extract, the quantity usually mixed with a quart of rain-water, are about the fifth part of an ounce, and may be supposed to suspend thirteen grains of Lead, if no change be produced, by combination, in the specific gravity of the compound. Each ounce, therefore, of the vegeto-mineral

mineral water contains only four tenths of a grain of this metal.

THE *Aqua Saturnina*, employed in the following case, was strongly impregnated with Lead, having an ounce of the Extract in every quart of water. On Thursday February 16, 1775, Mr. P——, a young man of a delicate habit of body, had a tea-kettle full of boiling water thrown upon his leg, by which the cuticle was separated from the knee to the toes. Oily applications were immediately used; but the pain and inflammation were so great, the following day, as to require the assistance of the ingenious surgeon (*b*), to whom I am indebted for this account. A gentle laxative was directed; the patient's leg and foot were well washed, every three hours, with Goulard's Saturnine Water; and afterwards covered with linen soaked in the same lotion, and wetted with it from time to time. The relief obtained, by these means, encouraged the young man's friends to use the lotion in an immoderate quantity; for, in six days, no less than seven quarts of water were consumed. On Wednesday night, the sixth from the first application of this remedy, the surgeon was called to his patient, and found him violently af-

(*b*) Mr. Starkie, of Manchester.

flicted with colic, trembling of the limbs,
 continual nausea, and frequent vomitings.
 He had been coſtive three days, and had neg-
 lected to take a purgative medicine preſcribed
 for him. It may be proper to point out the
 progreſs of theſe ſymptoms, as they ſeem to
 mark the gradual operation of the Lead. On
 Monday the conſtipation commenced, and a
 ſlight tremor was perceived in the ſcalded limb:
 The tremor continued on Tueſday: On Wed-
 neſday the colic ſupervened, which grew ex-
 tremely ſevere and alarming in the evening, and
 was aggravated by the ſickneſs and retchings
 which accompanied it. Directions were given
 to diſcontinue the lotion; the *Ceratum Sam-
 bucinum*, ſpread upon linen, was applied to
 the parts affected; and the following draught
 was adminiſtered every four hours.

R. Ol. Ricini V. O. ſubact. ʒſs.

Aq. Mentb. Pip. ſimp. ʒ i.

Tinct. Thebaicae gutt. vii.

Syr. e Meconio ʒ i. m. f. hauſtus.

SEVERAL motions were procured by the re-
 petition of this draught; the complaints of
 the patient became more moderate; and the
 colic entirely ceaſed before the next evening.
 But a ſoreneſs of the *abdomen* remained, and
 the body was left in a very irritable ſtate.

The

The scalded leg and foot, in eight days, were more healed than is usual, after such accidents, in three weeks, when unctuous remedies are employed.

I HAVE seen and examined the patient, whose case is here related ; and can attest the faithfulness and accuracy of this account.

THE facts which I have now adduced, in conjunction with those contained in my Treatise on the Poison of Lead, afford a strong presumption, that Saturnine preparations, externally applied, are not so perfectly innocent as they are too generally asserted and believed to be. One positive proof, well authenticated, out-weighs a thousand negative ones ; especially when such positive evidence is acknowledged but rarely to occur. And I shall be happy in the idea of having done some service to the community, if I can excite more attention to the operation, and more caution in the use of these topical remedies, which are deservedly esteemed, and universally employed. My design is not to disparage them, but only to recommend a just discrimination of their effects. Whenever tremors of the limbs, paralytic affections, costiveness, yellowness of the countenance, or pains in the bowels succeed the application of any Saturnine composition, the use of it should be for a while suspended, or entirely discontinued ;

and the proper antidotes to the poison of Lead should be sedulously administered. Thus will the danger be obviated on its first approach ; and we shall not be reduced to the sorrow and disgrace of having cured an ulcer, a burn, or a contusion, by inflicting the most excruciating tortures, or perhaps at the expence of life.

It has been observed in the Medical Essays, published by a Society at Edinburgh, “ that
 “ though opium produces such certain effects in
 “ the stomach, yet it is not clear, that it has any
 “ operation externally, even when applied to the
 “ bare nerves, in a part excoriated by a blister.”
 This has been urged as an argument against the topically poisonous action of Lead. But the observation is not founded in truth, and is contradicted by facts which daily occur in medical practice. For what physician is a stranger to the powers of opium when applied to the nerve of an aching tooth, or to the eyes in an *ophthalmia* ?

DR. HEBERDEN remarks, in his very ingenious lectures on poisons, that Lead affords a singular instance of a poison which only affects the nerves of motion : “ Tremblings, strong spasms,
 “ and palsies, are its usual consequences ; but
 “ I apprehend it has been seldom or never found
 “ to injure the understanding, or to make the
 “ patient delirious, till he becomes so, as is
 “ common

“ common in most distempers, by the near approach of death.” I believe this curious observation, with respect to the human species, may be just; but cats become frantic by swallowing Lead.

I HAVE observed, that pestles and mortars, for the use of apothecaries and others, are made of the *glazed* Burslem pottery. This must be attended with pernicious consequences; because the vitrified Lead will be dissolved by the acids, which are frequently employed in medicine; and the particles of it will be abraded by constant friction. Perhaps these particles may, also, be of such a size and sharpness, as to injure, by their mechanical action, the coats of the stomach; for the glazing is very unequally diffused over the surface of the coarser ware.

COPY OF A LETTER FROM DR. HAYGARTH, TO
THE AUTHOR, CONTAINING A PARTICULAR
ACCOUNT OF THE EFFECTS OF GOULARD'S
SATURNINE WATER ON THE SUFFERERS BY
THE EXPLOSION OF GUN-POWDER, AT CHESTER,
NOVEMBER 5, 1772.

CHESTER, *May* 31, 1773.

I SHOULD sooner, my dear friend, have answered your benevolent inquiries concerning the effects of Goulard's saturnine water upon the patients who suffered by the explosion of gun-powder in this city, on the fifth of November last; but the horrors of that tremendous scene, even at this distance of time, are so painful, that I feel a peculiar reluctance in recollecting their anguish and variety of wretchedness. Happy should I be, if this dreadful calamity could afford any useful instruction how, in future, to alleviate the miseries of mankind.

FROM the neighbouring coal-pits there are frequently sent to our Infirmary, patients, who, by the explosion of the inflammable vapour they contain,

contain, have been burnt on their faces, hands, and often a great part of their bodies which happened to be uncovered. Oil, in the usual method, had been generally applied to these burns. But the integuments were often so deeply affected, and to so large an extent, and the patients continued for many days in such exquisite pain, that their groans and lamentations were heard over the whole house. On this account, a trial was made in these cases of the saturnine water, and with the most happy event; the excruciating pains were immediately relieved, and the burns soon healed. The striking similarity of the cases afforded the most convincing argument, that the same remedy should be used in the burns from gun-powder.

ON the night of the fatal accident, thirty-three patients were admitted into the Infirmary; the hands and faces of all, with the arms and thighs of the women, were, in general, severely burnt. A considerable number of old patients, with other assistants, were most assiduously employed in washing all the burnt and bruised parts with the saturnine water, many times over, that night. The next morning I examined very attentively the appearance of the burns; they were very moderately inflamed, and upon their being asked, none of the patients complained of that painful burning vulgarly attributed to fire in the part,

except one young man whose legs were so deeply affected, that all the integuments sloughed off, and the sores could not be healed in less than six months.

I COMPARED very attentively the state of the burns, which had been thus treated, with those of twenty patients, who were admitted into the Infirmary the next and following days. Though the latter in general had received incomparably much slighter injuries, yet their burns appeared red, tense, and highly inflamed; and they complained of a severely painful burning in the parts affected. When the saturnine water had been plentifully applied to these burns, the pain and inflammation very soon abated.

As preparations of Lead, when taken internally, are known to produce such pernicious effects, the faculty have, with reason, doubted whether their external application were universally safe. On this account, I was particularly attentive in watching every symptom that might possibly arise from the poison of Lead, and can assure you, that, of these fifty-three patients, whose burns and contusions were very plentifully and frequently washed with the saturnine water, not one had the slightest symptom of colic or palsy, during the whole time of their recovery, though so many nerves were exposed to the immediate contact of the Lead.

THE only cases that proved fatal were three young girls, who were seized with the locked jaw, and died convulsed. Though this disease has never, that I know, been attributed to the poison of Lead, yet as this is a purely nervous affection, I will mention such particulars of each case, as will entirely remove all suspicion of this cause, by shewing that the injuries they received were fully adequate to such an effect. The poor girl, who was first seized with a locked jaw, had been so much hurt by the explosion, as to be unable to speak for twenty hours after the accident; and besides many severe contusions and burns, the *tendons* on the back of her hand were all laid bare by a deep burn. The second, besides large burns on her face, arms, and thighs, with a bad contusion on her head, had the *tendons* of her ham severely lacerated and burned. This patient complained to me, particularly, that a pain alternated between this wound, and the muscles of her neck and jaw, that were spasmodically affected. The third had a broken arm, large burns and contusions, but was not seized with a locked jaw, till the integuments on her *sacrum* were deeply mortified.

It is of importance to observe on the whole, that of one hundred and six persons, who were blown up by eight hundred pounds of gun-powder, twenty-three died almost instantly by the ex-

plosion; that among so large a number of the remainder as eighty-three, who had received such severe burns, contusions, fractures, and dislocations, so small a proportion as three only terminated fatally: fifty-three, who of this number had received the worst injuries, were admitted into the Infirmary. This very uncommon success I would chiefly attribute to a plentiful application of the saturnine water, together with copious evacuations, acid and acescent drinks, and supplying the wards both day and night so freely with fresh air, as entirely to clear away all the putrid effluvia, produced by so great a number of very large sores.

I am ever,

DEAR SIR,

With the sincerest Regard,

Your most faithful, and affectionate,

J. HAYGARTH.

COPY OF A LETTER FROM DR. ROTHERAM, OF
NEWCASTLE-UPON-TYNE, TO THE AUTHOR.

S I R,

I AM much obliged to you for the specimen of your Experiments and Observations upon the Poison of Lead. The subject is truly interesting; and I am very glad that you have taken it in hand, as I am sure the public will reap both pleasure and benefit from your inquiries.

WHILST I practised at Hexham, I was frequently consulted for the workmen in the Lead mines, Smelting mills, and Refineries, of which there are many in that neighbourhood; and I most sincerely repent my negligence in not taking proper minutes of those cases; had I done that, I might have now been able to have sent you an hundred of them; but alas! I have nothing but my memory to trust to, and therefore must speak chiefly in generals.

I HAVE ever looked upon Lead to be highly poisonous, when its particles are so minutely divided by heat, corrosion, solution, &c. as to
enter

enter the pores or absorbents of any part of the body, but more particularly those of the lungs and stomach; though I have sometimes suspected them to reach the brain itself; for as these very minute parts are rendered extremely volatile, especially by a strong heat, it is no wonder that they pervade some of the smallest pores, and penetrate into the inmost recesses.

THE people who work in the mines here are generally pretty healthy; and I believe your observation with regard to this point will commonly hold: Their disorders may mostly arise from the small broken pieces, dust, or washings: but I dare not assert this as an universal maxim, because I have some reason to believe that noxious effluvia are sometimes mixed with the air in old workings, and where they have not a proper number of air-shafts; and the people affected by this kind of foul air, shew very different symptoms from those who work in our coal mines. Asthmas, and those very obstinate ones, are a frequent consequence, and I believe almost universally attended with a blue expectoration, which lasts for several months, often attended with a *constipatio alvi*, and sometimes with spasmodic contractions of the muscles. I think I remember some of them paralytic; but, as I lamented before, for want of proper minutes I dare not be positive.

YOUR

YOUR observation of the cupolas is a very just one, and confirmed by plentiful experience in this neighbourhood; which leads me to make some remarks on the three branches of smelting, refining, and reducing; though they may not be new to you, yet as I have had frequent opportunities of attending to them, I shall trouble you with a few hints in each.

THE effluvia rising from all these works are soon condensed and concreted when they come into the cool air, and form a great deal of white substance, which lines the chimney of flues, and what rises out falls perceptibly on the ground, sometimes in small dust, at other times in little flakes, destroying a great part of the herbage; what remains gives the cattle the belland, and neither dogs, cats, nor poultry will thrive near any of these mills. The smelting business has generally been reckoned less noxious than the refining, and the reducing or running the litharge into Lead the worst of all; for they used always to reduce the litharge upon hearths, and indeed they still pursue this senseless method in some of our works; but the more provident ones have erected proper furnaces for this process, which convey the smoke to a greater distance; whilst the refiner stands at the mouth of the test constantly supplying it with Lead, regulating the fire and taking away the litharge, whilst the bel-
lows

lows behind, which are constantly skimming off the litharge, blow the effluvia full in his face. The quantity of these effluvia may be in some measure computed from the loss of Lead in refining, which generally amounts to at least one ton in thirteen, though I am apt to believe that more of this evaporates in the reducing than the refining; for the litharge like minium always exceeds the weight of the Lead from which it is produced; whereas probably twelve tons of litharge when it is run down will scarce produce eleven of Lead. To illustrate this a little farther, I took, the other day, five grains of litharge, and the like quantity of lead, and laid them upon separate pieces of charcoal which I held in my hand, and threw the flame of a lamp very strong upon them with a blow pipe. The litharge in a very few seconds run down into a clear piece of lead which weighed four grains and a half, the half grain evaporating almost instantly, and the vapour covered the charcoal for about an inch round, where it lay with a thin yellow, or rather greenish crust. The Lead was near half an hour in evaporating, but threw off the same kind of vapour; I observed from this that the litharge is much more volatile than lead, and the first fumes are probably more subtile and easier raised.

THE workmen in this country call the disorder by the name of the Mill-reck, and in general it
answers

answers to the short description you have given of it in Derbyshire. The most particular case which I remember was that of Thomas Wallace, a refiner, and who had formerly wrought in the mines; he consulted me about sixteen years ago; he had then violent pains and gripings, with costiveness and a numbness in his limbs. The medicine with which he was chiefly relieved was the gum pill with a third part of aloes, taken morning and evening. He went to work again, when his disorder soon returned, and brought a *gutta serena* upon one eye, and rather hurt the sight of the other; his left hand, if I remember aright, turned paralytic; which complaints baffled every effort which I made for his relief by purgatives, blisters, and nervous medicines. He then went recommended to the Bath Hospital; but, after using the waters, and such medicines as the physicians there prescribed for some time, he returned in the same paralytic state. I heard of him about two years ago, and I do not know but he may be yet living, and in the same condition; but as he is forty miles from hence, I have not frequent opportunities.

I know not whether the following experiment may lead to any conclusion in your way, but you may perhaps not be displeased with a trial, which you may easily make at your leisure. Some time ago I made several unsuccessful attempts to cor-
rode

rode or dissolve Lead in the vitriolic acid: I knew full well that infusing, boiling, or digesting would not do it; but I digested ground litharge for some time in oil of vitriol still without effect. At last an ingenious acquaintance, to whom I had communicated my thoughts, moistened some powdered litharge with distilled vinegar, and a day or two afterwards poured some water and oil of vitriol upon it, which instantly turned the whole mass into the most beautiful white Lead I ever saw; the vinegar doubtless acting as a medium of attraction betwixt the litharge and the vitriol. But the acid of vitriol separates the parts of the Lead too far, so that the substance, though it exceeds the best white Lead of the shops in colour, is greatly deficient in specific gravity; and no art which we have yet used can remedy this fault, and here I am afraid it must rest. For after several trials, it wants body to be of any use in painting; nor does it flux or vitrify easily enough to be of use in glazing the white earthen ware. But may not the minerals in some waters meet with some proportion of a similar medium, by which they may attract particles from leaden pipes, cisterns, &c. and thus carry off with them many noxious particles.

I HAVE long thought, and am lately more certain, that not only the generality of Lead Ores in this country, but often the Lead itself is more
heterogeneous,

heterogeneous, than has been imagined. I even doubt whether some of our Lead mines may not produce every known metal. Silver is well known to be contained in them all, though in widely different proportions; Mr. Cox, if I am not much misinformed, has lately produced a great quantity of copper from the slags or refuse of some of our smelting mills, and for this purpose has purchased large quantities; zinc we are sure is in some parts of the ore, and zaffre I have produced from other specimens, though I have not yet brought this last to such a certainty as I could wish. The copper sometimes unites with the Lead in smelting, and greatly injures it for the market, as it renders it harder and more brittle.

I MUST trouble you a little farther with expressing my doubts about your last paragraph. How far the fluxes used in folding the filigree may fix the parts of the arsenic, or from what other cause those workmen might escape, I dare not say; but I should notwithstanding strongly suspect the fumes of this very volatile and caustic mineral to be very prejudicial. Hildanus gives us several instances of bad effects from its external application in small quantities. Hoffman, in his *Metallurgia Morbifera*, sect. xvii. says, *Tristis casus memini, qui Lipsiæ contigit, dum in domo Stanniarii, qui arsenicum cum cupro admisceret, ab haustis ejus venenatis fumis, plures in eadem domo habitantes,*

habitantes, maligno morbo adjecti et mortui sunt.

Hoffman likewise tells us, in the same section, that the men employed in both digging and manufacturing the cobalt at Kuttenberg in Bohemia, are so affected with vomitings, syncoptic anxieties, cardialgias, difficulties of breathing, suffocations, tremors, &c. that they appear like living skeletons.

I FEAR I have too long trespassed upon your patience, and I doubt to little purpose; as you will have so much better and more pertinent information. I most heartily wish you all the success which you can desire: I hope you will command a great deal, but am sure you will merit more.

I AM, with thanks for the honour of your last correspondence,

Your much obliged,

and very humble servant,

J. ROTHERAM.

NEWCASTLE,
JULY 8, 1773.

A LETTER FROM DR. SAUNDERS, OF LONDON,
TO THE AUTHOR, ON PREPARATIONS OF LEAD.

JEFFRIES-SQUARE, February 1, 1776.

DEAR SIR.

BEING informed that you are preparing for the press a volume of Essays on philosophical and medical subjects, on the same plan with those already published, I am happy in this opportunity of communicating to you a few striking facts and experiments on some of the preparations of Lead, a subject which has already engaged your attention. Much has been written on the efficacy of the preparations of Lead, on external application; and their operation and effects are so well understood by surgeons, that little remains to be said upon this subject. It being however generally admitted, that the *Acetum Lithargyrites* or Goulard's extract is in its operation and powers the same as the *Saccharum Saturni*; I am desirous of correcting this popular error, by explaining

plaining the difference between these two preparations.

METALLIC BODIES acquire their causticity by an union with acids, with which they enter into a state of mixture; the activity is proportioned to the quantity of acid and the degree of solubility in the metallic salt. The variety in this respect in some metallic salts is so great, even where the acid in combination is the same, that the causticity acquired by a moderate proportion of metal is almost destroyed, when a larger proportion is added: This is illustrated by attending to the difference between corrosive sublimate and calomel, which are both preparations of mercury with the same acid. This reasoning will apply to the subject of Lead.

IN the preparation of the *Acetum Lithargyrites*, the acid is fully saturated with Lead; in the preparation of the *saccharum saturni*, the acid is in a much larger proportion to the Lead. The *Acetum Lithargyrites*, when diluted by the purest distilled water, gives out a copious precipitation which, from experiment, I find to be Cerussè. The *Saccharum Saturni* remains dissolved in distilled water, and is therefore applied topically in a state more immediately active, both from its greater proportion of acid, and its preserving its solubility under high degrees of dilution. I find
from

from experiment that, by adding a very small proportion of distilled vinegar to the *Aqua Saturnina* of Goulard, the white precipitate is redissolved, and that the solution procured in this manner is more active, but less adapted to remove inflammation, and abate irritation, as a sedative, than the *Aqua Saturnina* itself. I was first led to apply to this subject from an aversion to the use of turbid liquors, especially when the precipitation is produced by the pharmaceutical treatment of chemical mixtures. I am, however, perfectly convinced, that no degree of dilution of *Saccharum Saturni* will answer the many valuable purposes to be obtained from the use of the *Acetum Lithargyrites*. In the operation of medicines on the human body, a slow and gradual action is often to be desired, in preference to a more immediate operation from the same remedy, applied in a more soluble form. It is upon the same principle that the *Flores Zinci*, when diffused in water, in many cases, produce a better effect than a solution of the *Vitriolum Album* in any state of dilution; and that the *Kermes Mineral*, and some other preparations of antimony of a slow solubility, produce a more lasting operation, and possess more powers than even the *Tartar Emetic*, except in such cases where immediate and active evacuations are required, as in

the beginning of fevers and acute diseases. Water alone therefore, in the case of the *Aqua Saturnina*, proves a precipitant of Lead by attracting the acid, and reducing the preparation to a state of Cerusse, an intermediate state between Lead and the *Saccharum Saturni*; so that Cerusse diffused in water more nearly resembles the *Aqua Saturnina* of Goulard, than a solution of the *Saccharum Saturni* does. There is however an advantage in external application from the use of powdery bodies, in their state of precipitation, because they are in a more subtle form than any body can be rendered by mechanical triture. I have sometimes been of opinion, that various chemical mixtures are formed by the union of the same metal in its application to different proportions of the same acid, and that *Calomel* may be considered as the union of Mercury with *Corrosive Sublimate*, in which the acid was so much attracted and engaged, that it entered into a very imperfect union with the additional quantity of Mercury in *Calomel*; and that therefore the Mercury employed which produces Calomel, diminishes the activity of Corrosive Sublimate without acquiring solubility itself, and without losing much of its own phlogiston; hence the precipitates from Calomel and Corrosive Sublimate, by alkaline substances, differ so essentially
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in their nature. In the same manner the *Saccharum Saturni* may be considered as an union of Cerusse with Vinegar, whereas Goulard's *Acetum Lithargyrites* is an union of Lead with Vinegar.

To the same principle may be referred the power of fixed air in re-dissolving calcareous matter, after it had proved, in a smaller proportion, a precipitant for quicklime: So that although chalk may be considered as a combination of quick-lime and fixed air; calcareous matter dissolved in water by fixed air is an union of chalk and fixed air. We even find that though quicklime attracts fixed air stronger than the caustic fixed alkali; yet the caustic fixed alkali attracts fixed air more strongly than chalk does, and therefore precipitates chalk held in a state of solution by fixed air. This will probably best explain why the caustic alkali should prove a precipitant of calculous matter dissolved in the mephitic acid. I have mentioned these facts with a view to illustrate that it is a principle in chemistry, that various mixts are formed from the combination of two bodies, in different proportions to one another. It is upon a similar principle that metallic salts are rendered less active by abstracting their acid, either by attraction or calcination. An attention to these circumstances, derived from a knowledge of the chemical history
of

of bodies, may lead to some future improvements in the pharmaceutical treatment of many valuable remedies, and enable us to render chemical preparations more or less active, or more or less soluble, as the indications of cure may seem to require.

A LETTER FROM DR. JOHN CARTE TO DR. GREW, CONCERNING THE BELLAND, CAUSED BY THE FUMES OF LEAD; EXTRACTED FROM DR. HOOKE'S PHILOSOPHICAL EXPERIMENTS, PUBLISHED BY MR. DERHAM, F. R. S.

MANCHESTER, *October* 27, 1678.

I THOUGHT it might be worth while to give you a short account of a distemper in Derbyshire, very common among those, who are employed in the smelting-mills, *i. e.* the houses where they melt the Lead down from the ore; it is by the country people called the *belland*, but for what reason I cannot learn; it is hard to give a concise definition of it, because it seldom appears but under the disguise of another disease.

THIS *belland* frequently imitates the *tormina ventris scorbutica*, but in a most exquisite manner, which is usually accompanied with extreme costiveness, and a continued suppression of urine; sometimes appears like an *asthma convulsivum*, sometimes a continued and obstinate *dyspnœa*, and often seizes the *genus nervosum*, either in a paralytic resolution of the parts, or in spasms.

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It has a different effect upon men, according to their age; if they come not to the work of the mills, till they are full grown, or of a middle age, they suffer mostly the aforementioned pains of the belly, or difficult breathing. But if taken in while young, and growing, they are subject to the palsy; their limbs (especially their fingers) being often irrecoverably resolved: Or sometimes have their fingers so contracted, as to render them, perhaps for ever, incapable of working: Both which I have seen.

I COULD not be informed of any specifics, they had for this disease; but that a decoction of *coliquintida*, in ale, was very common among them. I remember once an old man complained to me of the *belland*; it oppressed him in the nature of an *asthma*; I advised him to sulphurate medicines, which did relieve him. The contraction of the fingers I have known cured, by often putting the arms into hot grains after brewing.

I HAVE not observed, whether any of those, that are paralytic by the *belland*, die hectic, as Dr. *Pope* relates of them, at the *mercurial* mines in *Firmly*, but it seems not improbable that they may.

THIS distemper is not only incident to men, but other creatures, as horses, cows, dogs, cats, hens, geese, &c. but, especially, cats are subject
to

to it: Indeed few creatures that are young, will live near these mills without the *belland*.

Dogs do in their fits howl and tumble up and down, foaming like *epileptics*; this the people impute to the pain of their bellies.

I KNOW a small rivulet, on which some of these mills stand, wherein trouts have been caught, which have been supposed affected with the *belland*, by the irregularity of their growth, their heads being great and misshapen, their backs crooked, their tails very small, which I am apt to think might proceed from their feeding on the *smitham* or *dust* that is washed down at a flood: For not only the fumes, but also the washings of lead ore, and the *waste* (as they call it) *i. e.* the dust that remains, after the ore is melted, is very noxious to most sorts of creatures, and for this reason, they that live near the mills, dare not water their horses at the river, upon a flood.

THESE poisonous fumes are not only hurtful to animals, but also injurious to vegetables; for if the smoke be driven much upon any one place, it destroys all the grass of it.

Now that the *belland* in men, or other creatures, proceeds mostly from the smoke, will be easily granted; but what these fumes are impregnated with, is the question. Some fancy them to be antimonial; but then, methinks, they

should have the same effect with the flowers of that mineral, and I never heard that any of them were inclined to vomit. I am much more apt to think, that the *mercury* in the ore is the cause, both because they that work in the *mercurial* mines, are subject to the like symptoms, especially the palsy; and also I am told, that this *belland* often begins with a swelling of the glands about the throat, which, perhaps, if not prevented, might terminate in salivation. But why *mercury* should operate so variously upon bodies, differing in age, is a question will hardly be solved, till it appear more plainly, whether it be nearer akin to alcalies or acids: Its effect is easily foretold in bodies that abound with acids, whether scorbutic or venereal; but in younger persons whose humours are more insipid, and their blood freer from both fixed salts and acids, it may, perhaps, fix itself upon the nerves, as the coolest parts, and impede the motion of the spirits; but I had rather hear other's reasons about the cause of these things, than trouble you with my own.

SOME other things I have been informed of by the workmen, as that a little spar mixed with the lead ore, promotes its fusion, I suppose, as the yellow marchasite, that's found with silver, makes that metal flow the sooner: That if there be any hollywood in the fire, it hinders the fluxing

ing of the ore, which is certainly caused by the glutinous sap of that wood.

THAT the smoke is observed to follow the water very much: I suppose the coldness of the water does condense the fumes, as is seen in reviving *mercury* from *cinnabar*. A blue film is observed on the surface of those waters, where the smoke falls.

THAT a man may, by wetting his finger in his mouth, or common water, draw it through melted lead or iron, without any prejudice.

SIR, these observations will seem barren, yet as good as I could make among these people of the *Peak*, few of which can give a rational account of either what they do, or suffer, in such matters.

I am,

SIR,

Yours, &c.

